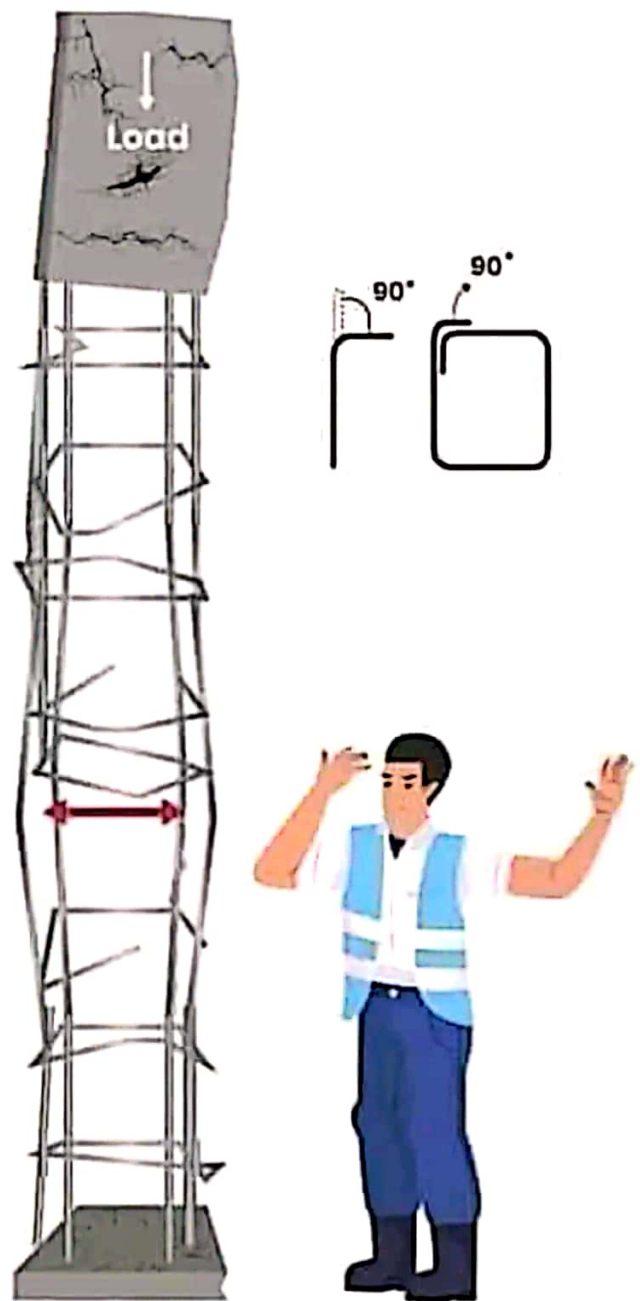
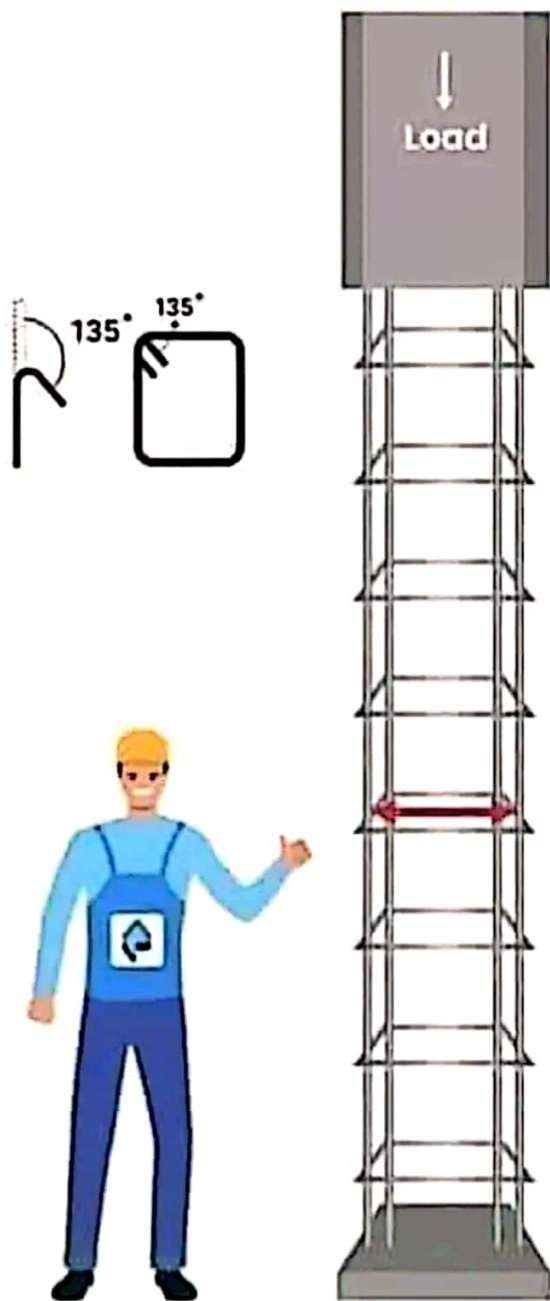




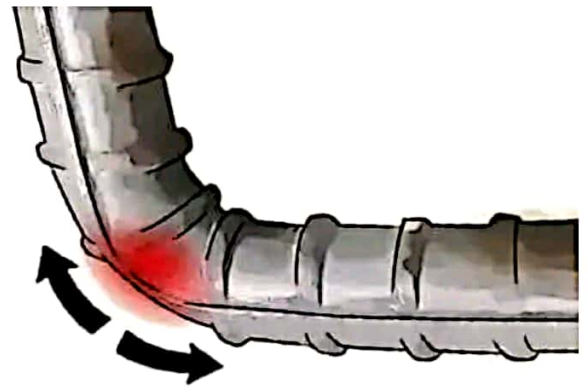
Site Engineer Handbook Pdf

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Bend Deduction Length of Bars

civil engineers 07



$$45^\circ = 1d$$

$$90^\circ = 2d$$

$$135^\circ = 3d$$

$$180^\circ = 4d$$

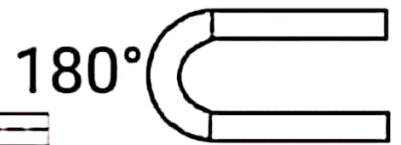
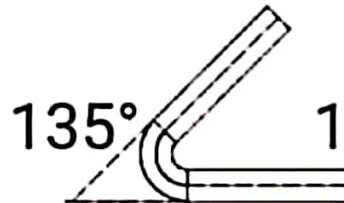
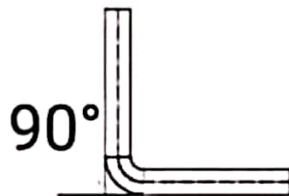
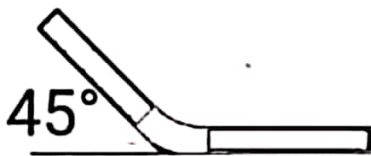
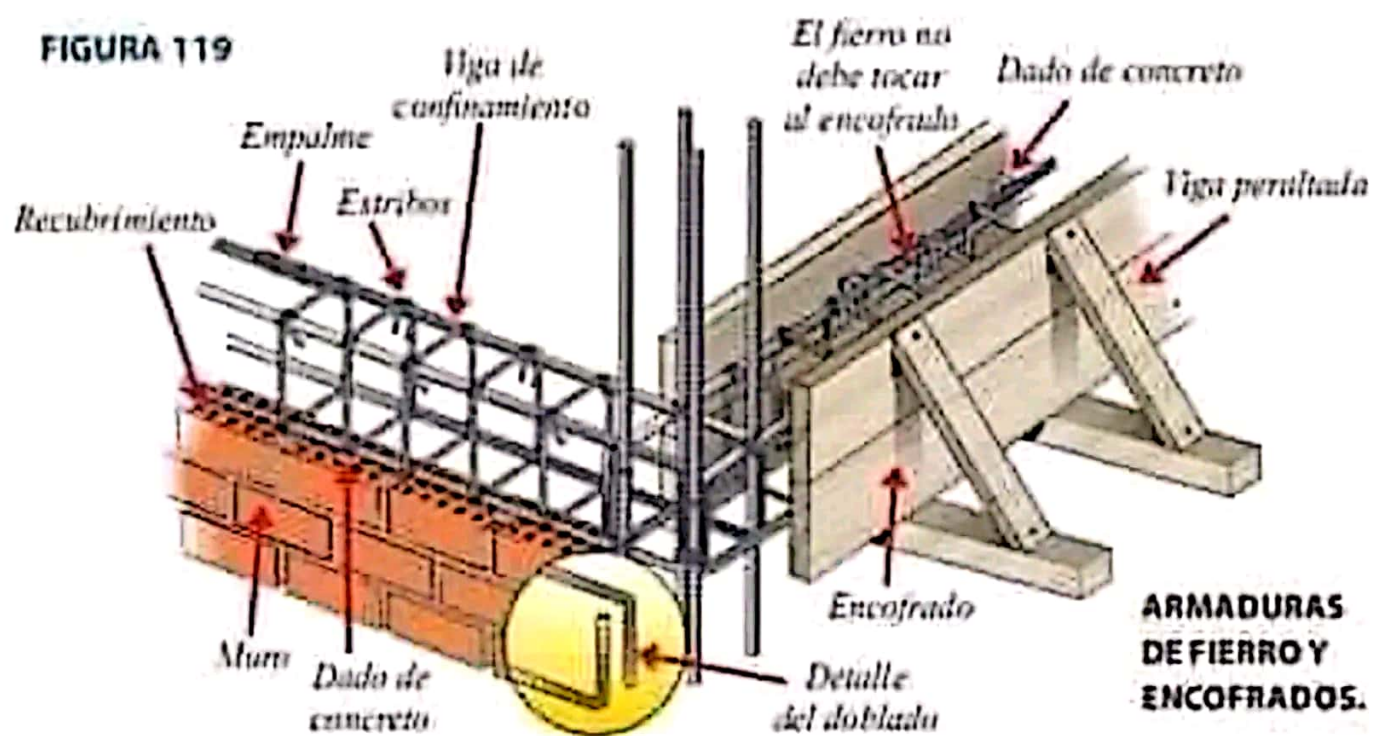
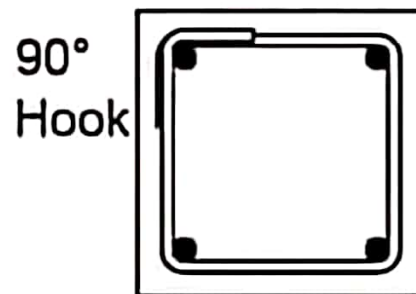
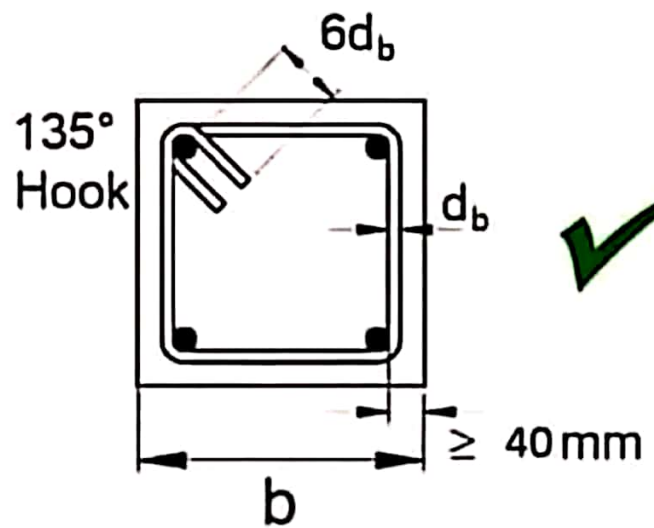
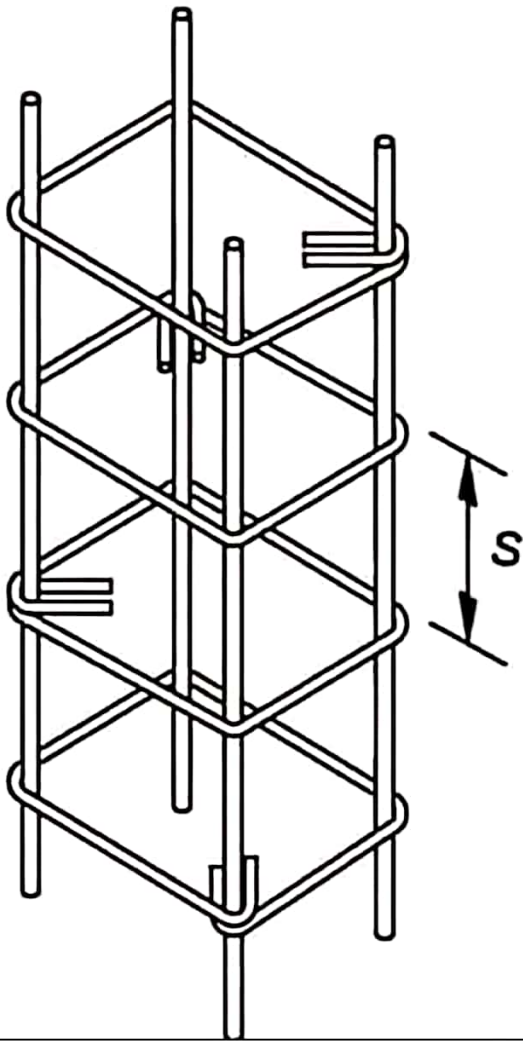
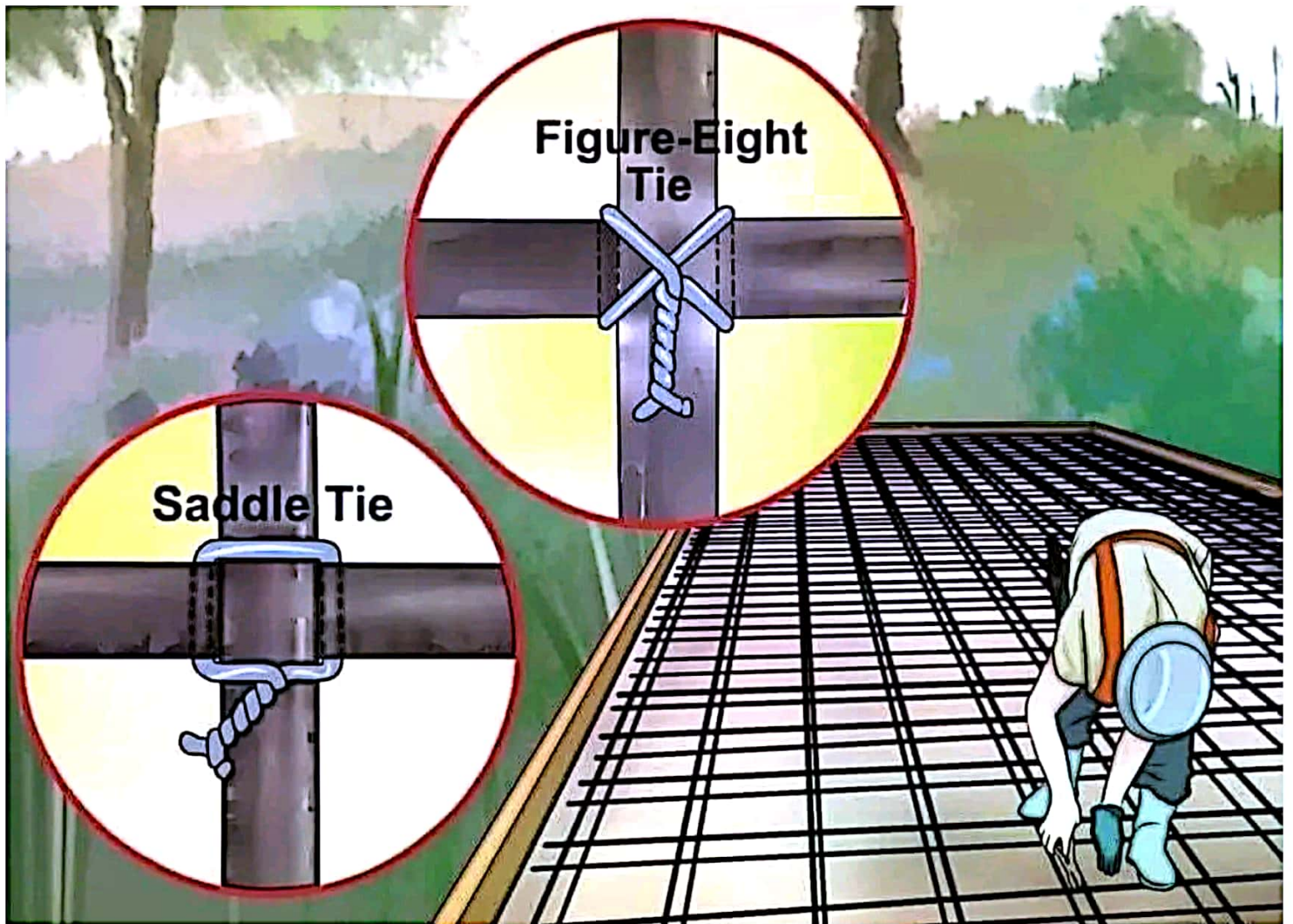


FIGURA 119



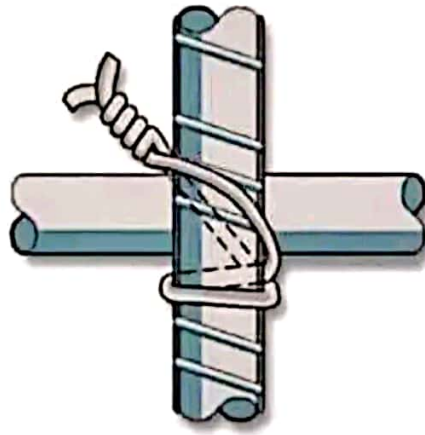
Important concept



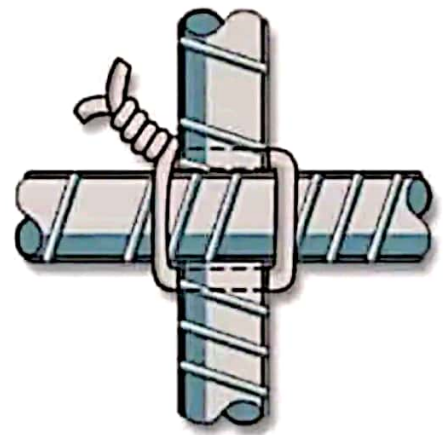




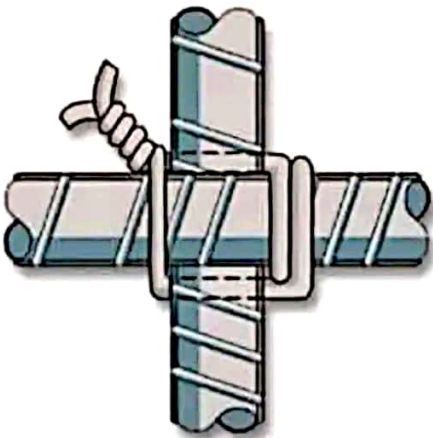
Slash, simple or snap ties are the most commonly used infill ties. Often the wire ties are doubled for added strength.



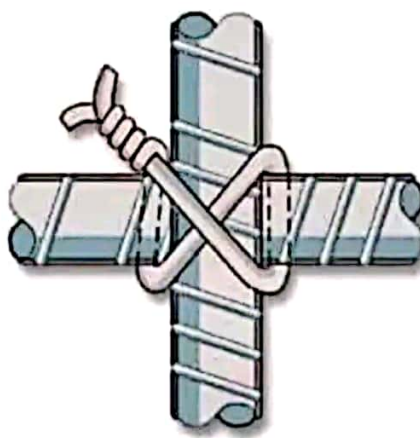
Ring-slash or wall ties prevent bar displacement and are often used to tie smooth stirrups to main deformed bars.



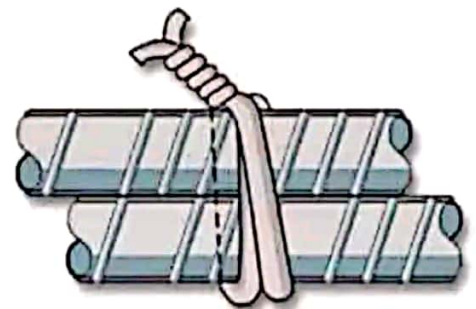
The *hairpin or saddle tie* is used as an alternative to the ring-slash tie and is excellent for key bars.



The *ring-hairpin or saddle tie with a twist* is sometimes used to tie main bars and to prevent bar displacement.



Crown tie, cross tie or figure-eight tie is a common tie used on main bars for setting up and tying springy bars.



The *splice tie* is used when tying lapped lengths of rebar etc.

FORMULA FOR WEIGHT OF REBAR (IN KG) = $\frac{D^2}{162}$ WHAT IS 162

WHAT IS

$$\frac{D^2}{162}$$



Basic - Density = $\frac{\text{Mass}}{\text{Volume}}$

Mass = Density x Volume

Mass (Wt) = Density of Steel x Area x Length

Skill Rachna Institute of Technology

DERIVATION OF UNIT WEIGHT OF REINFORCEMENT FORMULA

$$\frac{D^2}{162}$$



➤ Mass (Weight) = Density of Steel x Area x Length

➤ Weight = $7850 \times \frac{\pi D^2}{4} \times L$

❖ Generally the diameter of Rebar is measured in mm and Length in m, so making all the units in m

➤ Weight = $7850 \times \frac{\pi D^2}{4 (1000 \times 1000)} \times L$

➤ Weight = $\frac{D^2 \times L}{0.066165} = \frac{D^2}{162} \times L$

□ $1 \text{ mm} = \frac{1}{1000} \text{ meter}$

□ $\frac{1}{0.0661653} = 162$



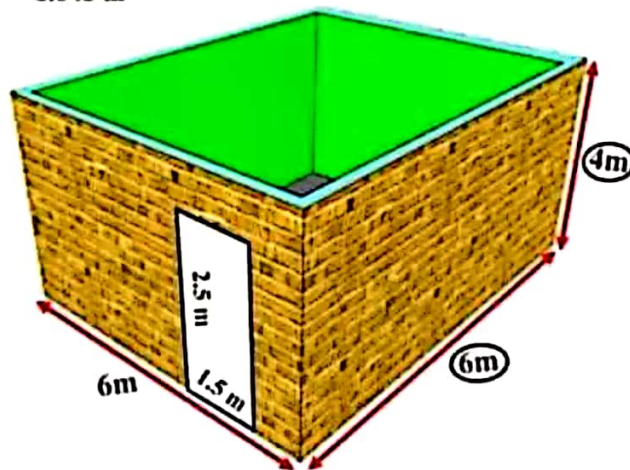
Type of soil & loading condition	Suitable foundation
Structure load is less and soil is medium to dense	Shallow footing
Structure load is heavy & soil is medium to loose	Either raft or deep footing
Structure load is heavy and soil is medium to loose	Raft + Pile
S.L is heavy & foundation is to be placed in running water	Well foundation
If swelling pressure is high and differential swelling value is $> 35\%$	Either raft or deep footing
Footing area $> 40\%$ of plinth area	either raft or combined
Soil is loose saturated sand which is prone for liquification	Compaction piles

How To Calculate Quantity Of Plaster

$$\text{Volume of Plaster} = 92.25 \text{ m}^2 \times \left(\frac{20}{1000}\right) = 1.845 \text{ m}^3$$

$$\text{Dry volume of Plaster} = 1.27 \times 1.845 \text{ m}^3$$

$$\text{Dry volume of Plaster} = 2.34 \text{ m}^3$$



Weight = 50 kg

Volume = 0.03472 m³

Ratio = 1 : 4

Sum of ratio = 1 + 4
Sum of ratio = 5

External Plaster = 20 mm

Internal Plaster = 12 mm

$$\text{Cement} = \frac{1}{5} \times 2.34 \text{ m}^3 = \frac{0.468 \text{ m}^3}{0.03472 \text{ m}^3} = 13.5 \text{ bags}$$

$$\text{Sand} = \frac{4}{5} \times 2.34 \text{ m}^3 = 1.87 \text{ m}^3$$



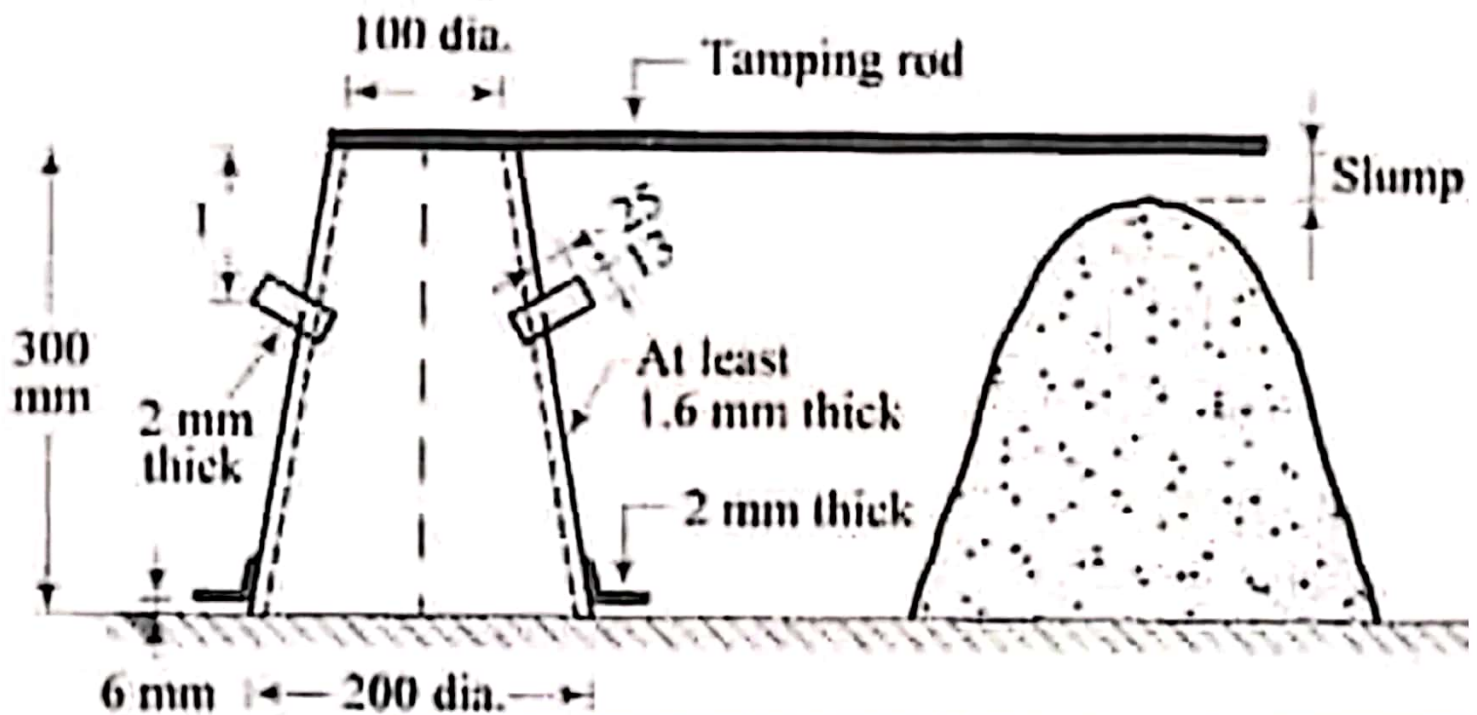
Calculating steel quantity of a footing

- * **Number of bars** = $\{(\text{width of footing} - 2 \times \text{clear cover}) \div \text{Spacing of bars}\} + 1$
- * **Length of a bar** = $\text{Length of footing} - 2 \times \text{clear cover} + 2 \times \text{end hook}$
- * **Weight of steel bars** = $\text{Length of bars} \times \text{unit weight}$

RECOMMENDED SLUMPS FOR VARIOUS TYPES OF CONSTRUCTION

TYPES OF CONSTRUCTION	SLUMP, MM	
	Maximum*	Minimum
Reinforced Foundation Walls and Footings	75	25
Plain Footings, Caissons, and Substructure Walls	75	25
Beams and Reinforced Walls	100	25
Building Columns	100	25
Pavements and Slabs	75	25
Mass Concrete	75	25

*may be increased 25mm for methods of consolidation other than vibration



CONCRETE MIXTURE PROPORTION

GRADE M30

PROPORTION 1 : 1 : 3
STRENGTH 30 MPA

GRADE M25

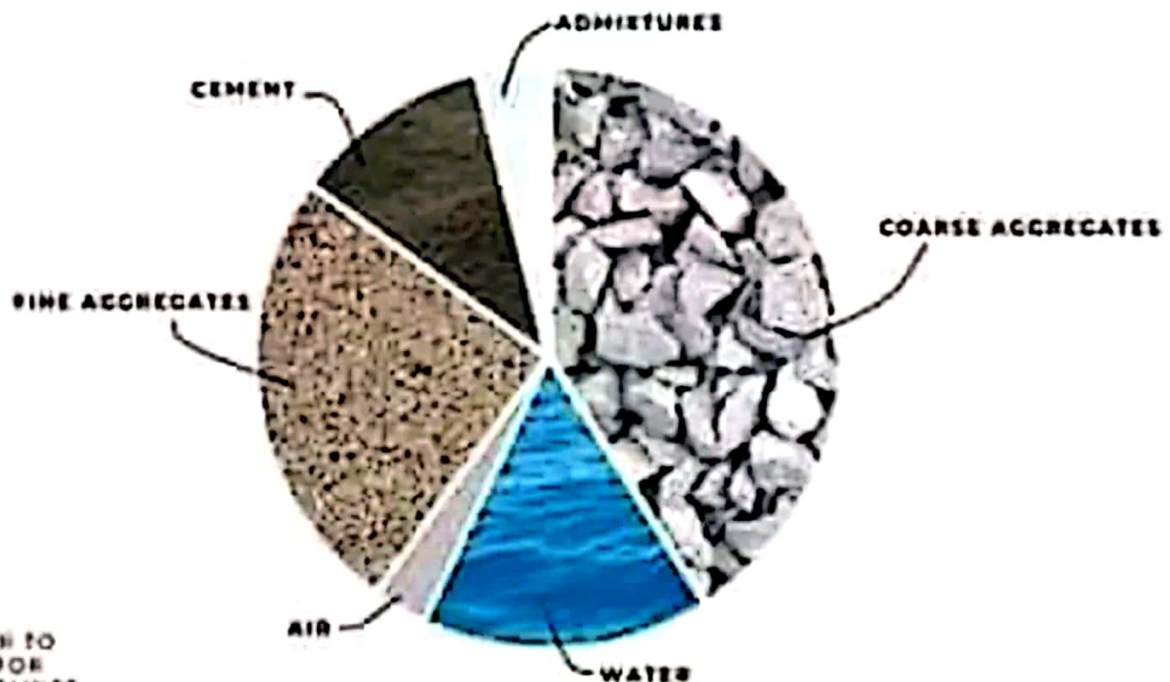
PROPORTION 1 : 1 : 2
STRENGTH 25 MPA

GRADE M20

PROPORTION 1 : 1.5 : 3
STRENGTH 20 MPA

GRADE M15

PROPORTION 1 : 2 : 4
STRENGTH 15 MPA



NOTE: REFER TO
SPECS FOR
MORE GUIDELINES

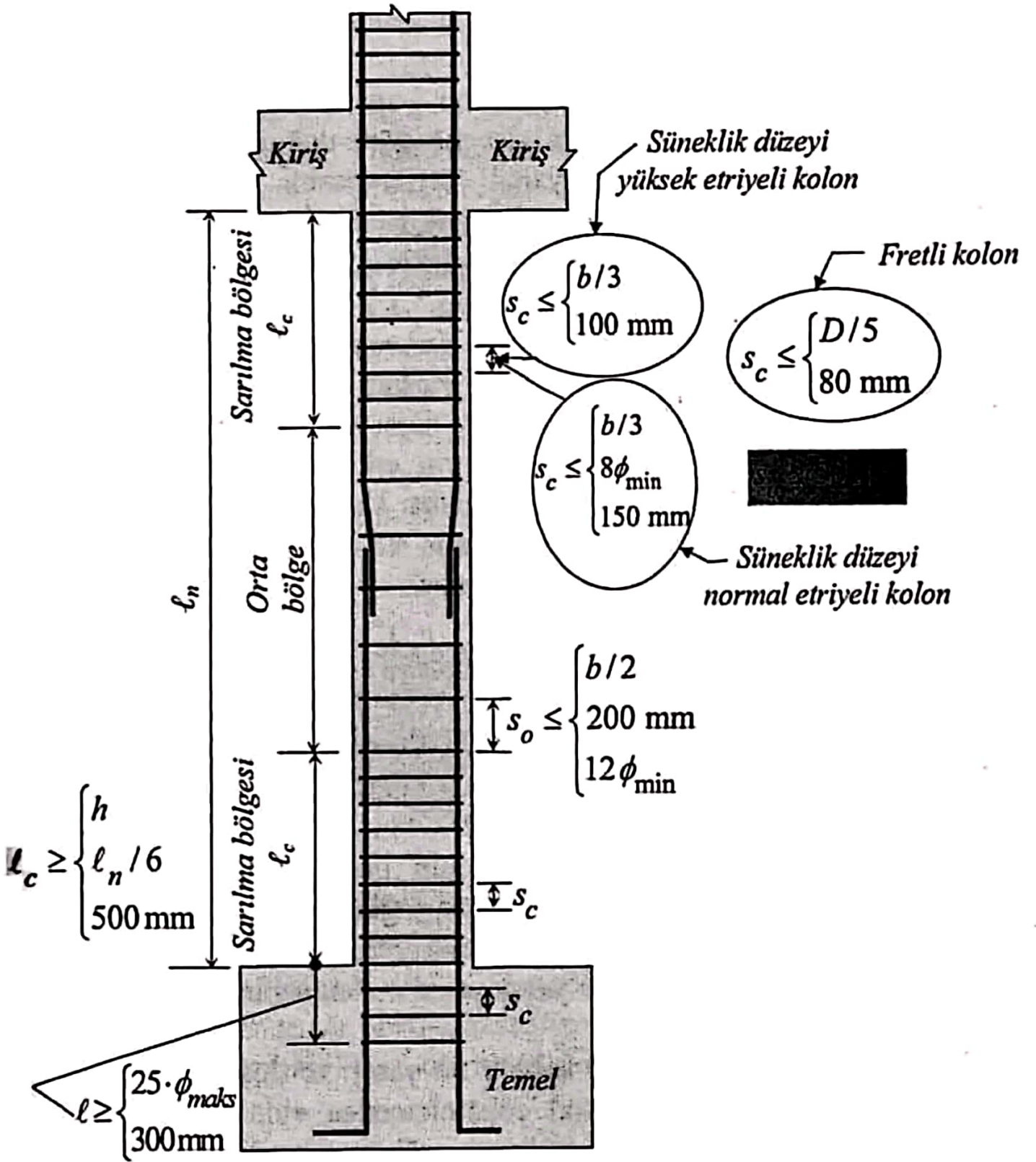
 **A&ED**

Clear Cover to Main Reinforcement

- 1.FOOTINGS : 50 mm
- 2.RAFT FOUNDATION.TOP : 50 mm
- 3.RAFT FOUNDATION.BOTTOM/SIDES : 75 mm
- 4.STRAP BEAM : 50 mm
- 5.GRADE SLAB : 20 mm
- 6.COLUMN : 40 mm

1-8. UNIT OF MEASUREMENTS OF COMMON ITEMS OF WORK

Earth work in excavation	- m ³
Earth work in filling	- m ³
Concrete work	- m ³
Reinforcement	- kg
Brickwork (9" thick or more)	- m ³
Plastering	- m ²
Painting	- m ²
Flooring	- m ²
Skirting	- r.m.
Brickwork (4 1/2" thick)	- m ³
Structural steel Work	- kg
Door, windows, gates	- m ²
Grills	- m ² (or kg)
Water line, sewer line, drainage pipe	- r.m.
Retaining wall	- m ³
Pointing	- m ²
Road, foot paths (each item of work, e.g. subgrade, soling, WBM, Bituminous carpeting)	- m ²
M.S. pipes for steel structure	- r.m.
Manholes, chambers	- no.
Plumbing and sanitary fittings, hardware	- no.
Railing	- r.m.
Soling	- m ²

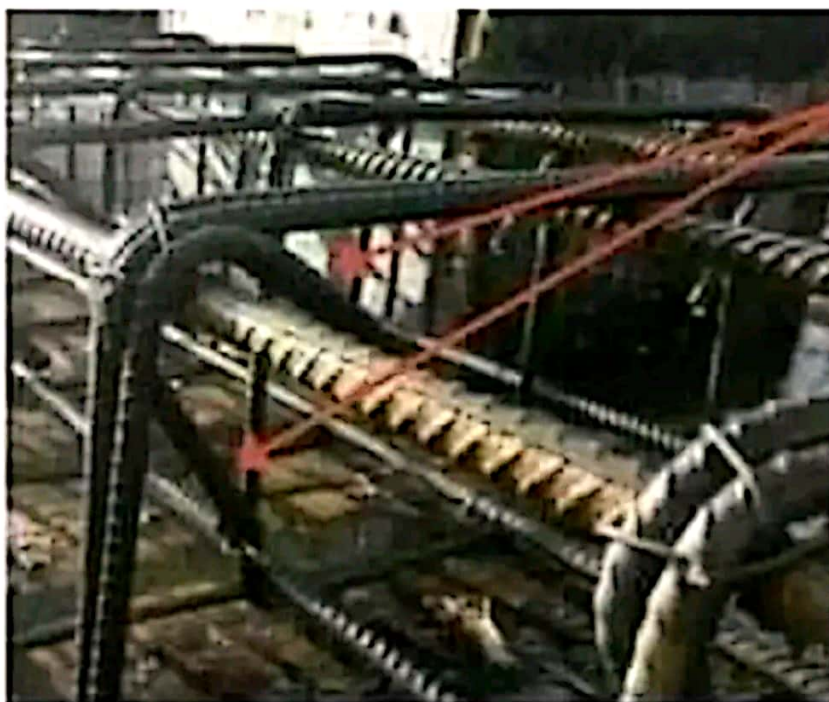


Şekil Kolonlarda enine donatılara ilişkin koşullar

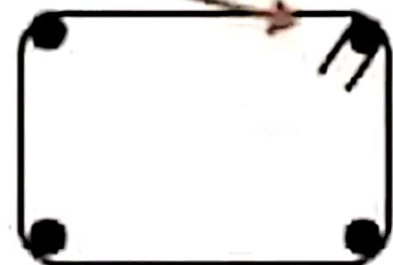
1. Hook Length:-

The hook length is commonly provided for stirrups.

Hook Length = $9D$ [D is Diameter of the Bar]



Hook Length



$9D$



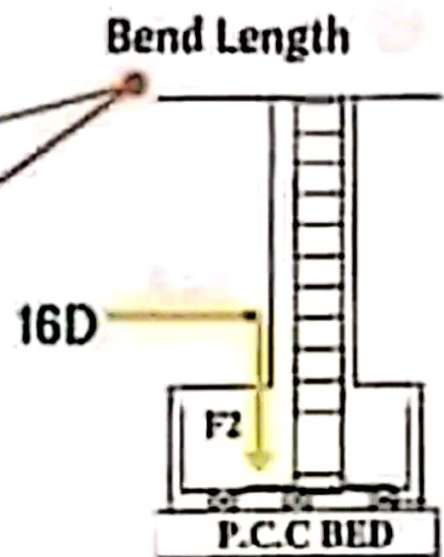
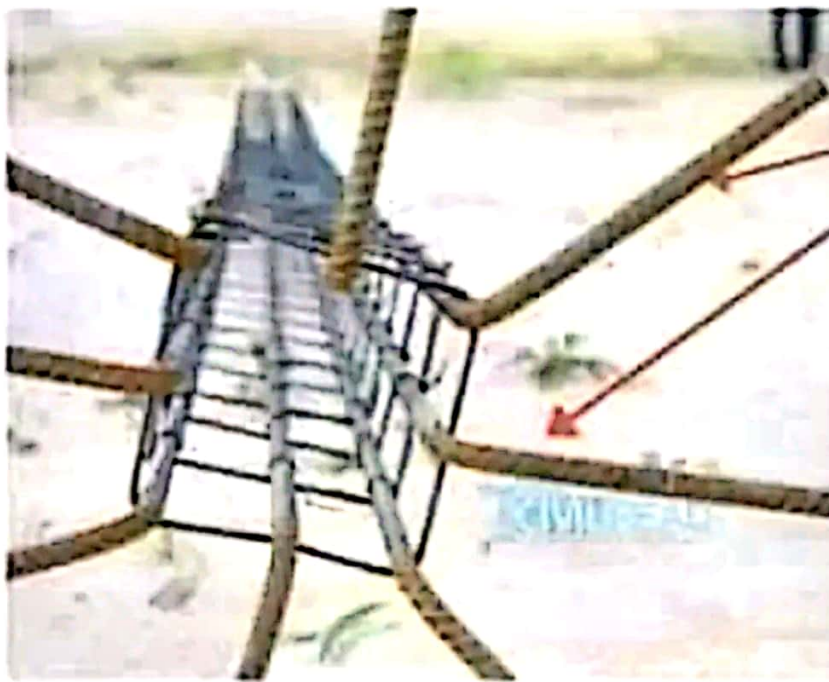
www.civilread.com

HOOK LENGTH = $9D$

2. Bend Length:-

Bend Length is usually provided in columns at ends to tie the columns to the footings.

Bend Length = $16D$ [D is Diameter of the Bar]



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BEND LENGTH = $16D$

How to calculate weight of 5 meter length Reinforcement

As per given data ,

Length of Rebar = 5 meter

Diameter of rebar = 10 mm



$$\text{Formula to calculate weight of rebar in kg} = \frac{D^2}{162.2} \times \text{length of rebar}$$

$$\text{So, Weight of rebar} = \frac{(10)^2}{162.2} \times 5 = 3.08 \text{ kg}$$

Hence, Weight of 5 meter length rebar = 3.08 kg

Derive $W = \frac{D^2}{162.198} \times L$

Weight = volume $\times$ unit weight

$$W = V \times w$$

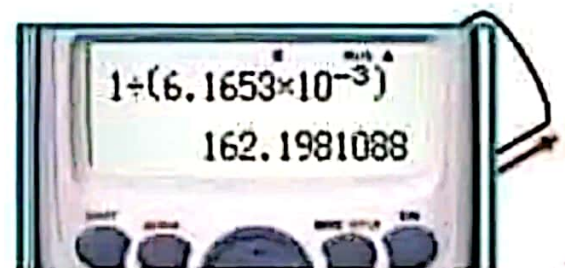
$$W = \frac{\pi D^2}{4} \times L \times 7850$$

$$W = 6165.375583 \frac{\times D^2 \times L}{1000^2}$$

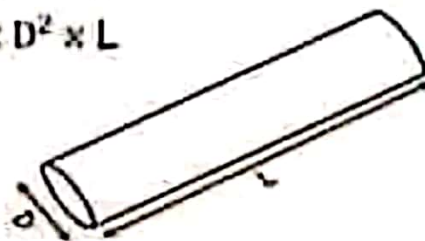
$$W = 6.1653755 \times 10^{-3} \times D^2 \times L$$

$$W = \frac{1}{162.198}$$

SLK's TuT's



$$\frac{1}{162.198} = 6.1653755 \times 10^{-3}$$

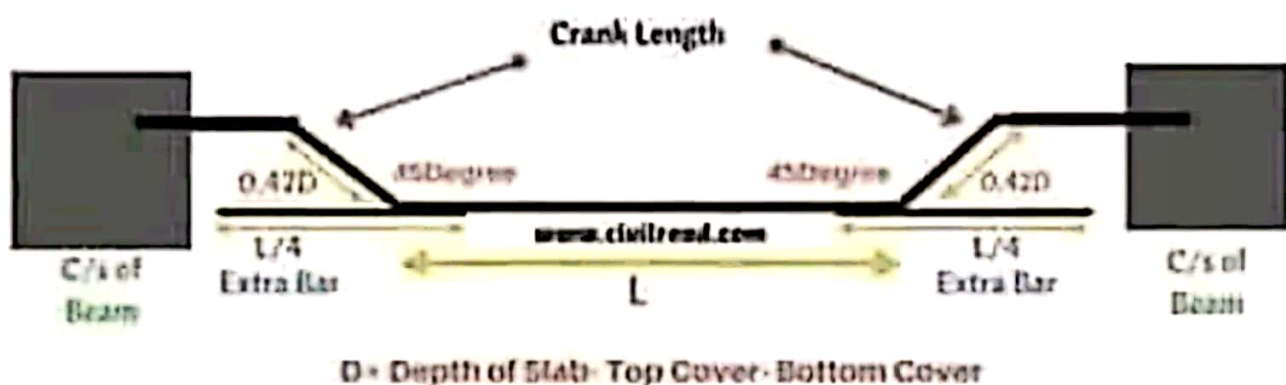


4. Crank Length :-

Crank length is provided in Slab Shear stress is maximum at supports in Slab. So, to resist this stress we usually crank the bars at the ends of supports in slab.

Crank bar is bent up at an angle of 45degree with the length of $0.42D$

D = Depth of Slab-Top Cover-Bottom cover



5. Extra Bar:-

Now a days Extra bar is also provided under every crank bar. To keep crank bar in position. (Refer above image for clear idea)



The length of Extra bar is $L/4$.

Q. 7 How do you Calculate Weight of 10mm dia. And 12 m length Steel Bars on-site?

By Multiplying Unit Weight of 10 mm dia. Steel with Length,

$$\begin{aligned}\text{Weight} &= \text{Unit Weight} \times \text{Length} \\ &= (D^2 / 162) \times 12 \\ &= (10^2 / 162) \times 12 \\ &= 0.617 \times 12 \\ &= 7.40 \text{ kg}\end{aligned}$$



Binding Wire

- As per IS 2502, Reinforcement are tied by binding wires, diameter not less than 0.9 mm
- Generally 10 kg binding wire required for 1 ton reinforcement as per design.
- For Slab: 2.7 kg for 10 sqm area.

18 Gauge



Weight of Different Steel Bars

MS Steel round & square Bar

Sr.No.	Dia. of steel bar	Weight per meter	
		Round Bar	Square Bar
1	6 mm	0.22 Kg.	0.28 Kg
2	8 mm	0.39 Kg	0.50 Kg
3	10 mm	0.62 Kg	0.78 Kg
4	12 mm	0.89 Kg	1.13 Kg
5	16 mm	1.58 Kg	2.01 Kg
6	20 mm	2.46 Kg	3.14 Kg
7	25 mm	3.85 Kg	4.91 Kg
8	28 mm	4.83 Kg	6.15 Kg
9	32 mm	6.31 Kg	8.04 Kg
10	36 mm	7.99 Kg	10.17 Kg
11	40 mm	9.86 Kg	12.56 Kg
12	45 mm	12.49 Kg	15.90 Kg
13	50 mm	15.41 Kg	19.62 Kg

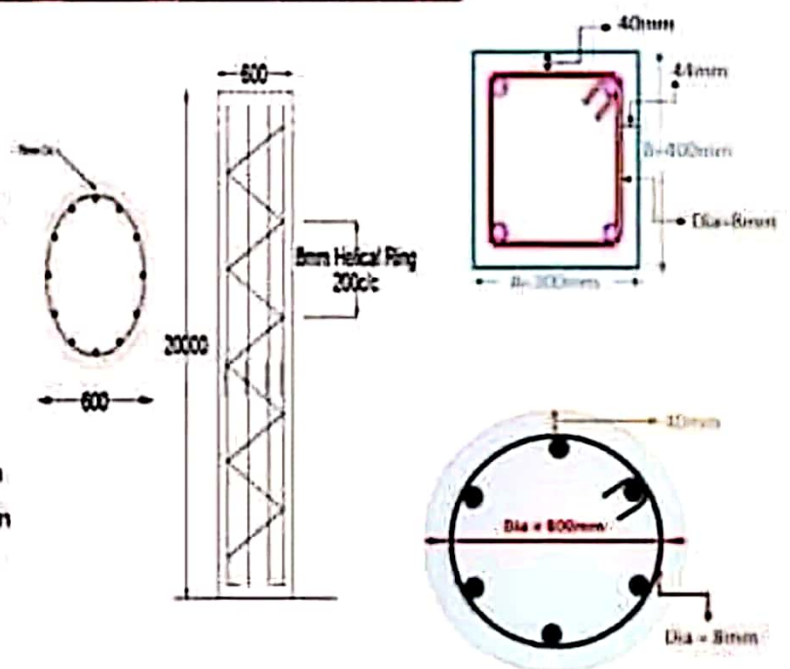
How To Calculate Cutting Length Of Stirrups

Rectangular Column:

Size Of Column = 300mm × 400mm
 Length Of Column (A) = 300 - (2 × 44) = 212mm
 Breadth Of Column (B) = 400 - (2 × 44) = 312mm
 Hook Length = 10 D = 10 × 8 = 80 × 2 = 160mm
 Cutting Length Of Stirrup = (A × 2) + (B × 2) + Hook Length
 = (212 × 2) + (312 × 2) + 160
 = 1208 mm / 1000 = 1.208m

Circular Column:

Dia Of Column = 600mm
 Dia Of Stirrup c/c = 600 - (2 × 40) - (4 + 4) = 512mm
 Parameter Of Stirrup = $\pi d = 3.142 \times 512 = 1608.704\text{mm}$
 Hook Length = 10 D = 10 × 8 = 80 × 2 = 160mm
 Cutting Length Of Stirrup = Parameter Of Stirrup + Hook L
 = 1608.704 + 160
 = 1768.704 mm / 1000 = 1.768m



How to Find Weight of Pipes (Fast)

Given: Length = 6m
Internal Diameter = 14cm
External Diameter = 16cm

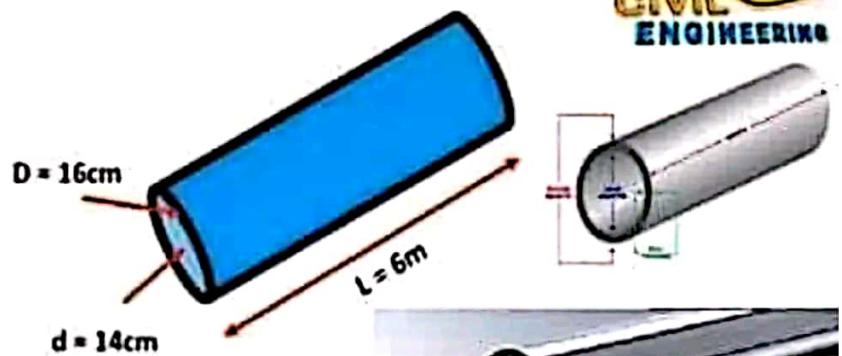
Weight = volume × unit weight

$$\text{Volume} = \frac{\pi (D^2 - d^2)}{4} \times L$$
$$= \frac{\pi (0.16^2 - 0.14^2)}{4} \times 6$$

$$= 0.028 \text{ m}^3$$

$$\text{Weight} = 0.028 \times 7850$$

$$= 219.8 \text{ kg}$$



Density of Steel = 7850 kg/m³

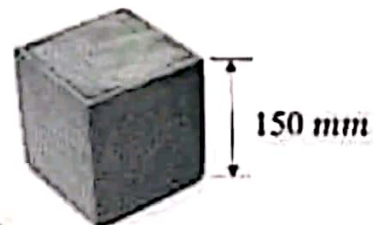
What are the grades of concrete according to "IS 456: 2000" ?

Grade of Concrete is measured by standard **compression** test on concrete cube of 150 mm.

M10, M 20, M30

M refers to mix

Characteristics **compressive** strength (f_{ck})
expressed in MPa (N/mm²)



20 samples

It is defined as the strength of material below which not more than 5% result are expected to fall.

Test results

23.8, 25.1, 25.4, 26.9, 27.3, 27.6..... 20 results

→ Increasing order

Grade of concrete - M 25

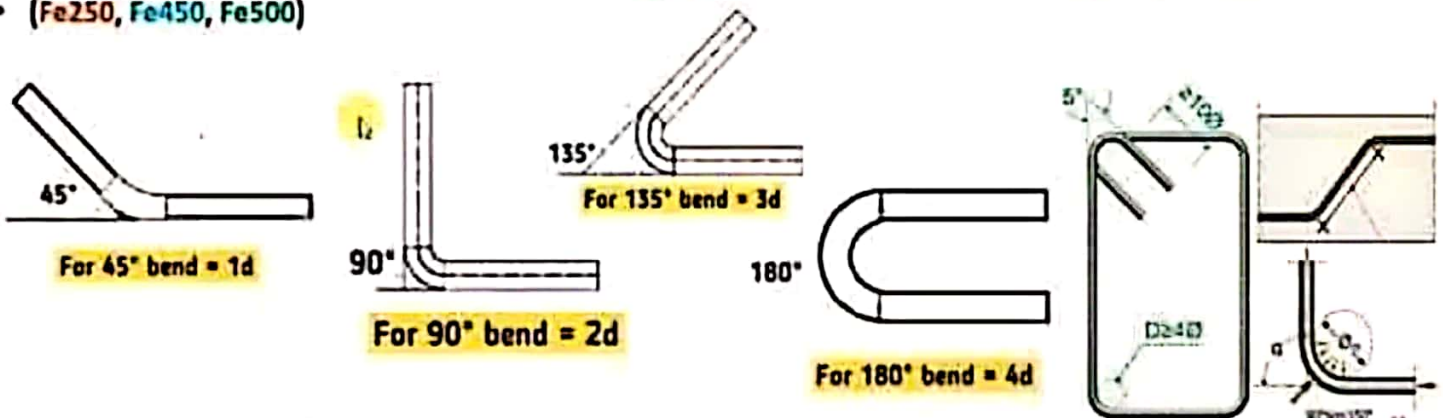
$f_{ck} = 25$ MPa

Types of concrete	Grade
High Strength concrete	Above M 60
Standard Strength concrete	M25 to M 55
Normal Strength concrete	M 10 to M20

Bend Deduction Length of Bars in BBS | Bend Elongation



- When we bend a steel bar, the length of the bar slightly increased due to stretching in the bending area.
- The expansion of length depends on the grade of steel and the degree of bend.
- The length increases with the increase of bending degree and decreases with the higher grade steel.
- (Fe250, Fe450, Fe500)



Example: if we are asked to select a suitable size for a **circular water tank** to store **20000 liters** of water for a residential building. Note that the tank depth should not be more than **2 meters**.

Solution/Design:

$$\text{Total Capacity of Tank} = \frac{20000}{1000} = 20\text{m}^3$$

Tank volume = Base area x depth

$$20\text{m}^3 = \frac{\pi D^2}{4} \times d$$

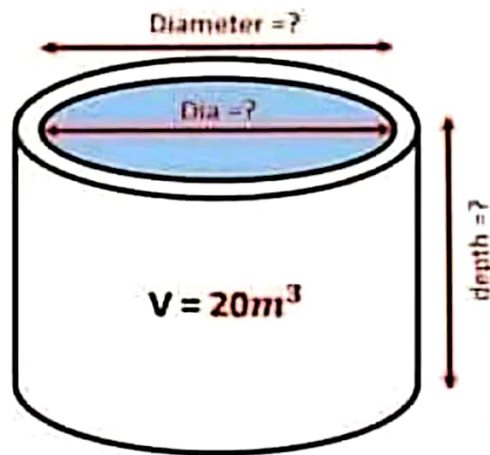
Trials:

If depth = 0.5 meter then diameter = ?

If depth = 1 meter then diameter = ?

If depth = 1.5 meter then diameter = ?

If depth = 2 meter then diameter = ?



Final Design

$$20\text{m}^3 = \frac{\pi(D)^2}{4} \times 0.5$$

So if depth = 0.5m then Dia = 7 m

$$\frac{20\text{m}^3}{0.393} = \frac{0.393(D)^2}{0.393}$$

and if depth = 1m then Dia = 5 m

and if depth = 1.5m then Dia = 4.12 m

$$\sqrt{50.90} = \sqrt{(D)^2}$$

and if depth = 1.5m then Dia = 4.12 m

Provide 1.5 meters depth and 4.12 say 4.10 meters diameter.

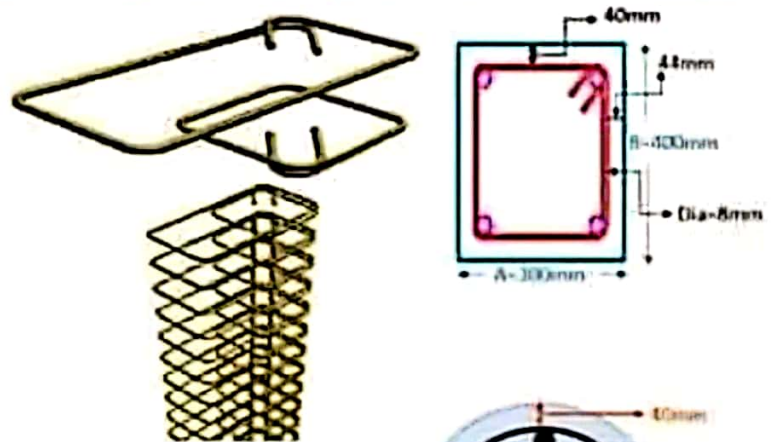
$$D = 7.13 \text{ m} \quad \text{Say } D = 7 \text{ meters}$$

and if depth = 2m then Dia = 3.56 m

How to Calculate Cutting Length of Rectangular Stirrups & Circular Stirrups

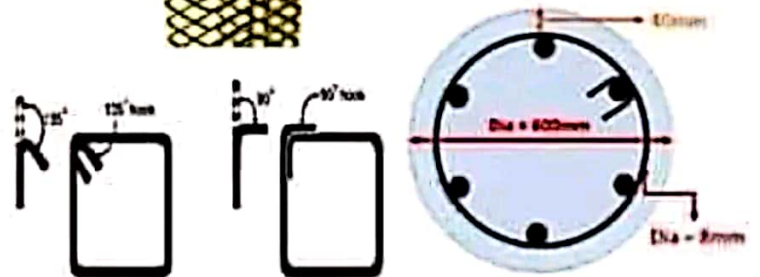
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 Hook Length = 10 D = 10 × 8 = 80 × 2 = 160mm
 Cutting Length Of Stirrup = Parameter Of Stirrup + Hook L
 = 1608.704 + 160
 = 1768.704 mm / 1000 = 1.768m



What Is 1.54 In This Calculation?

$$\text{Volume} = 1 \times 1 \times 1 = 1 \text{ m}^3 (\text{Wet Volume})$$

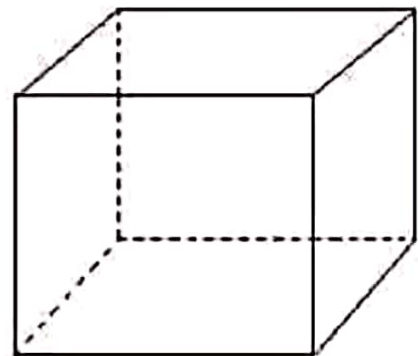
Wet Volume $\xrightarrow{54\% \uparrow \uparrow \uparrow}$ Dry volume

$$\text{Dry Volume} = \text{Wet Volume} + 54\% \text{ Of Wet Volume}$$

$$= 1 + \left(\frac{54}{100} \times 1 \right)$$

$$= 1 + 0.54$$

$$= 1.54 \text{ m}^3$$



Cube Dimension

Length = 1m

Breadth = 1m

Height = 1m

To convert 1 m³ Concrete From Wet To Dry volume = 1.54

To Convert 'n' m³ Concrete From Wet To Dry Volume = 1.54 × n

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Example#1 Design a circular sewer pipe having average discharge equal to 40 liter/sec.
Sewage velocity is 1.5 m/sec.

Design solution:

$$\text{Max flow} = 40 \times 3 = 120 \text{ liter/sec} = 0.12 \text{ m}^3/\text{sec}$$

$$\text{Max flow} = 0.12 \text{ cumec}$$

$$\text{Full flow} = 0.12 \times 1.5 = 0.18 \text{ cumec}$$

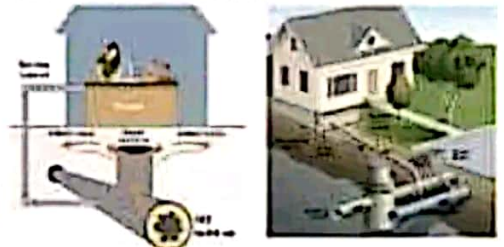
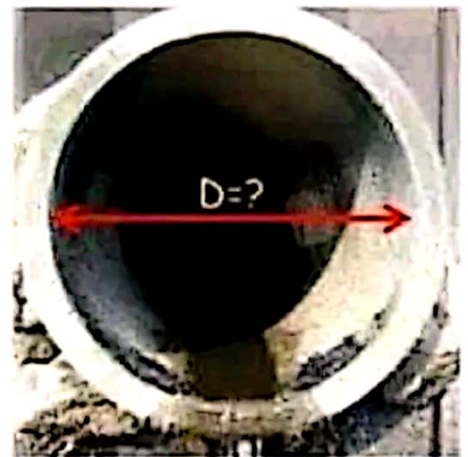
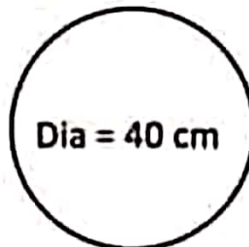
$$\text{Remember! } Q = A \times V \text{ Or } A = \frac{Q}{V}$$

$$A = \frac{0.18}{1.5} = 0.12 \text{ sq.m}$$

$$4 \times \frac{\pi D^2}{\pi 4} = \frac{0.12 \times 4}{\pi}$$

$$\sqrt{D^2} = \sqrt{0.1527887454}$$

$$D = 0.3908820095 \text{ m Or } D = 39 \text{ cm Say } D = 40 \text{ cm}$$



Reinforced Steel

Grade of Steel: Represented by yield strength of steel

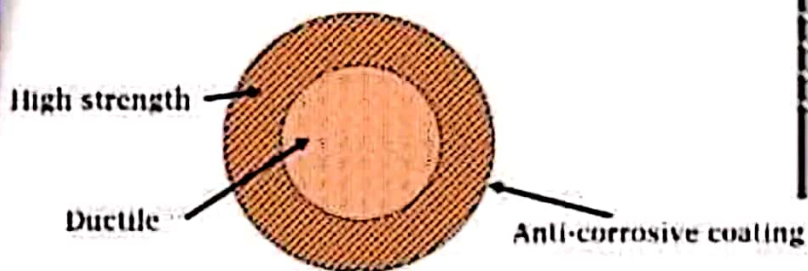
Cl. 36.1 – Specified yield strength may be treated as characteristic strength f_y .
(Expressed in N/mm^2)

- ❑ Mild steel (Fe 250): less commonly used because of their low strength.
- ❑ HYSD (High Yield Strength Deformed) Bars. e.g. Fe 415, 500
- ❑ Fe 415D, Fe 500D, Fe 550 and Fe 550D (IS 1786:2000)
- ❑ TMT Bars: Thermo mechanically Treated(TMT)
Inner core – soft and ductile
Outer core – very high tensile strength

Rebars – Reinforcing Bars

Size of Bars...

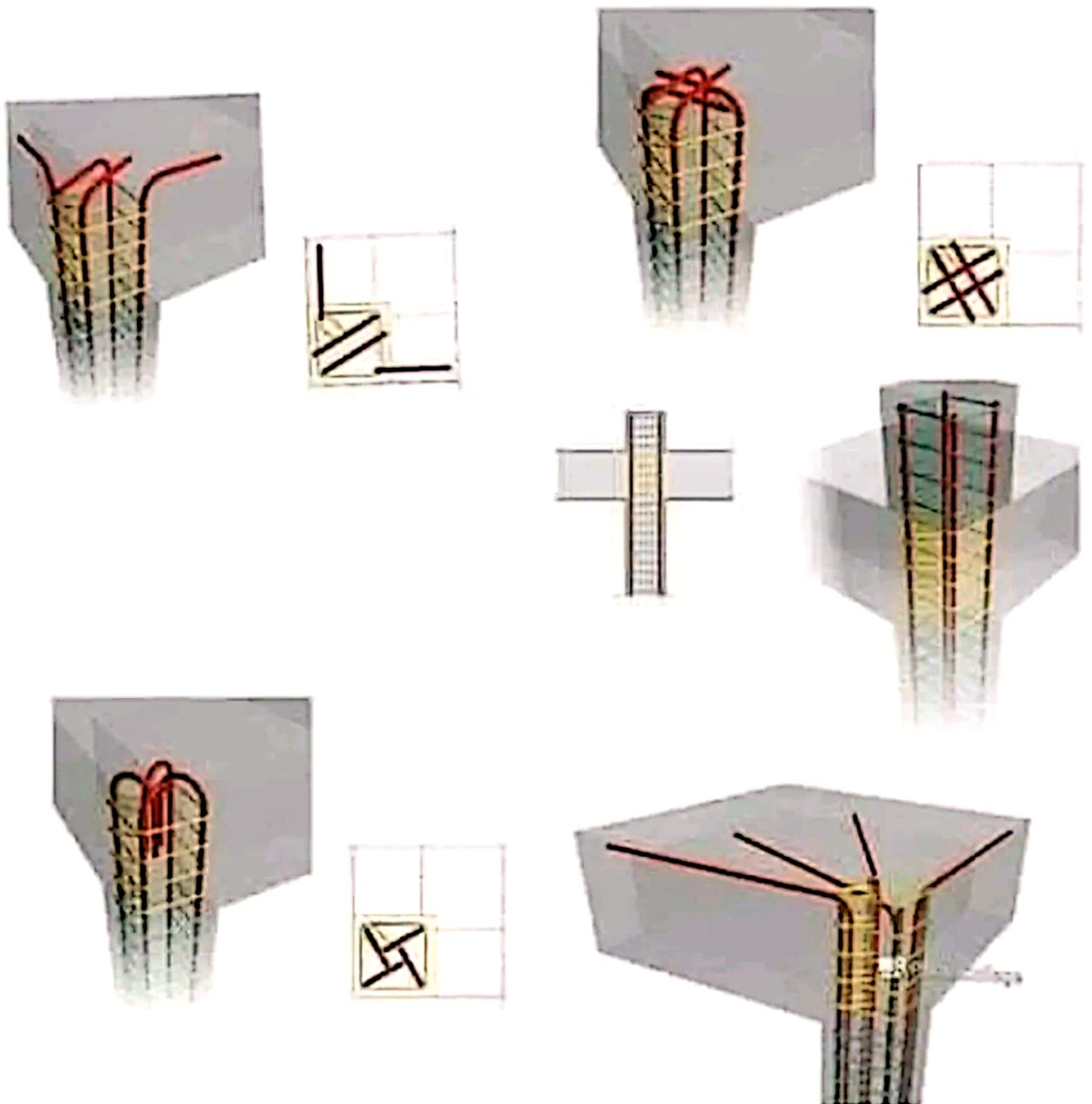
Nominal diameters - 5 mm to 50 mm.



STEEL QUANTITY CALCULATION PER M3 FOR SLAB/LINTEL, BEAM, COLUMN, FOUNDATION



Structural Element	Quantity of steel		Quantity of steel	
	Min.	Max.	Min. (kg/m ³)	Max. (kg/m ³)
Slab/Lintel	0.70%	1.00%	54.95	78.5
Beam	1.00%	2.00%	78.5	157
Column	0.70%	6.00%	62.8	471
Foundation	0.70%	0.80%	39.25	62.8



How to Calculate cutting Length of Bend Up Bars?

Given,

Clear Span of Slab = 8000 mm

Clear Cover of Slab = 25 mm

Thickness of slab = 150 mm

Diameter of steel Rod = 12 mm

Development Length (L_d) = 40 d



Now,

Total Cutting length of bend up bar,

$$= \text{Clear Span} + (2 \times 0.42 H) + (2 \times L_d) - (1 D \times \text{No. of bend}) - (2 D \times \text{No. of Bend})$$

$$= 8000 + \{2 \times 0.42 \times (150 - 2 \times 25 - D)\} + (2 \times 40 \times 12) - (1 \times 12 \times 4) - (2 \times 12 \times 2)$$

$$= 8937.92 \text{ mm}$$

$$= 8.9378 \text{ meter}$$

$$H = \text{Thickness of slab} - 2 \times \text{clear cover} - D$$

$$H = 150 - 2 \times 25 - 12 = 88 \text{ mm}$$

How to Calculate cutting Length of Bend Up Bars?

Given,

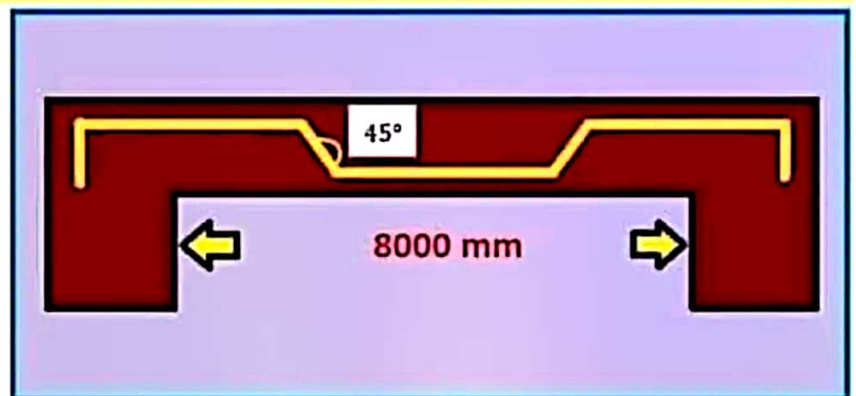
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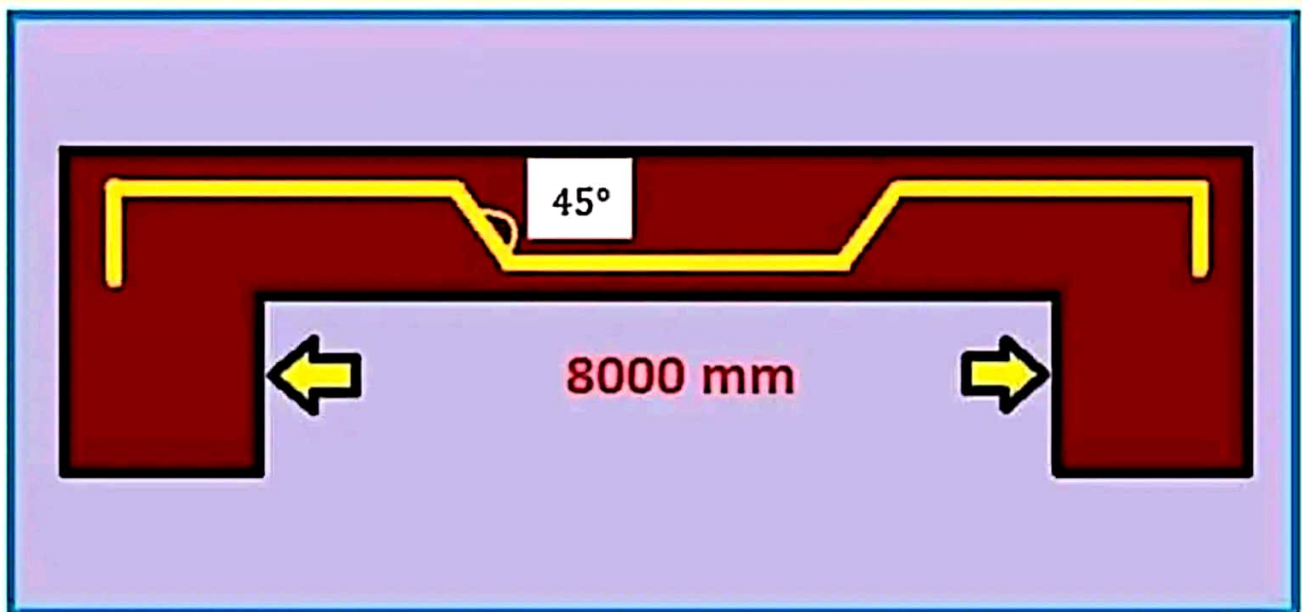
$$= 8000 + \{2 \times 0.42 \times (150 - 2 \times 25 - D)\} + (2 \times 40 \times 12) - (1 \times 12 \times 4) - (2 \times 12 \times 2)$$

$$= 8937.92 \text{ mm}$$

$$= 8.9378 \text{ meter}$$

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$$H = 150 - 2 \times 25 - 12 = 88 \text{ mm}$$

How to Calculate cutting Length of Bend Up Bars?



How to calculate quantity of Paint

UK Gallon = 350 ft² WET Wall

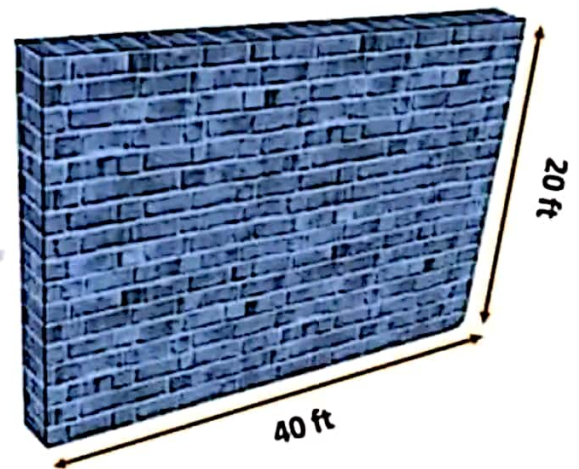
$$\text{Surface Area of Wall} = 40 \times 20 \\ = 800 \text{ ft}^2$$

$$\begin{aligned} \text{Quantity of Paint} &= \frac{800}{350} \\ &= 2.285 \text{ gallon} \\ &= 2.285 \times 4.540 \text{ liters} \\ &= 10.78 \text{ Liters} \end{aligned}$$

UK Gallon = 200 ft² DRY Wall

$$\text{Surface Area of Wall} = 40 \times 20 \\ = 800 \text{ ft}^2$$

$$\begin{aligned} \text{Quantity of Paint} &= \frac{800}{200} \\ &= 4 \text{ gallon} \\ &= 4 \times 4.540 \text{ liters} \\ &= 18.16 \text{ Liters} \end{aligned}$$



US Gallon = 3.785 liters

UK Gallon = 4.540 liters

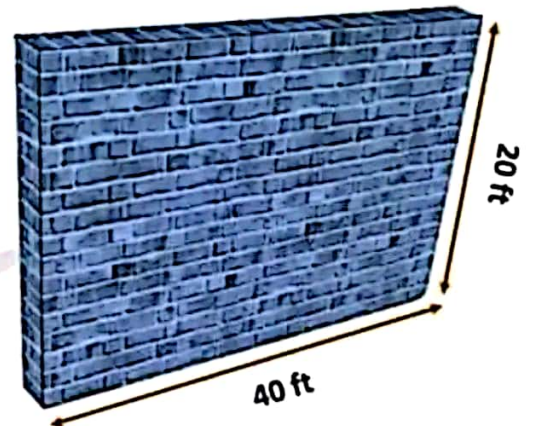
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How to calculate quantity of Paint

There are **two** types of **gallons**.
US gallon & **Uk** gallon.

1 US Gallon = 3.785 liters

1 UK Gallon = 4.540 liters



Thumb Rule For Paint Calculation

Generally, 1 gallon of paint can cover up to 350 sft area of **wet** wall & 1 gallon of paint can cover up to 200 sft area of **dry** wall.

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How to calculate quantity of Paint

US Gallon = 350 ft² WET Wall

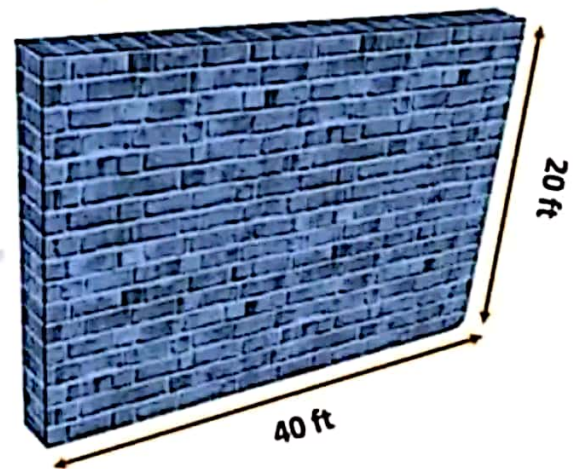
$$\text{Surface Area of Wall} = 40 \times 20 \\ = 800 \text{ ft}^2$$

$$\begin{aligned} \text{Quantity of Paint} &= \frac{800}{350} \\ &= 2.285 \text{ gallon} \\ &= 2.285 \times 3.785 \text{ liters} \\ &= 8.65 \text{ Liters} \end{aligned}$$

US Gallon = 200 ft² DRY Wall

$$\text{Surface Area of Wall} = 40 \times 20 \\ = 800 \text{ ft}^2$$

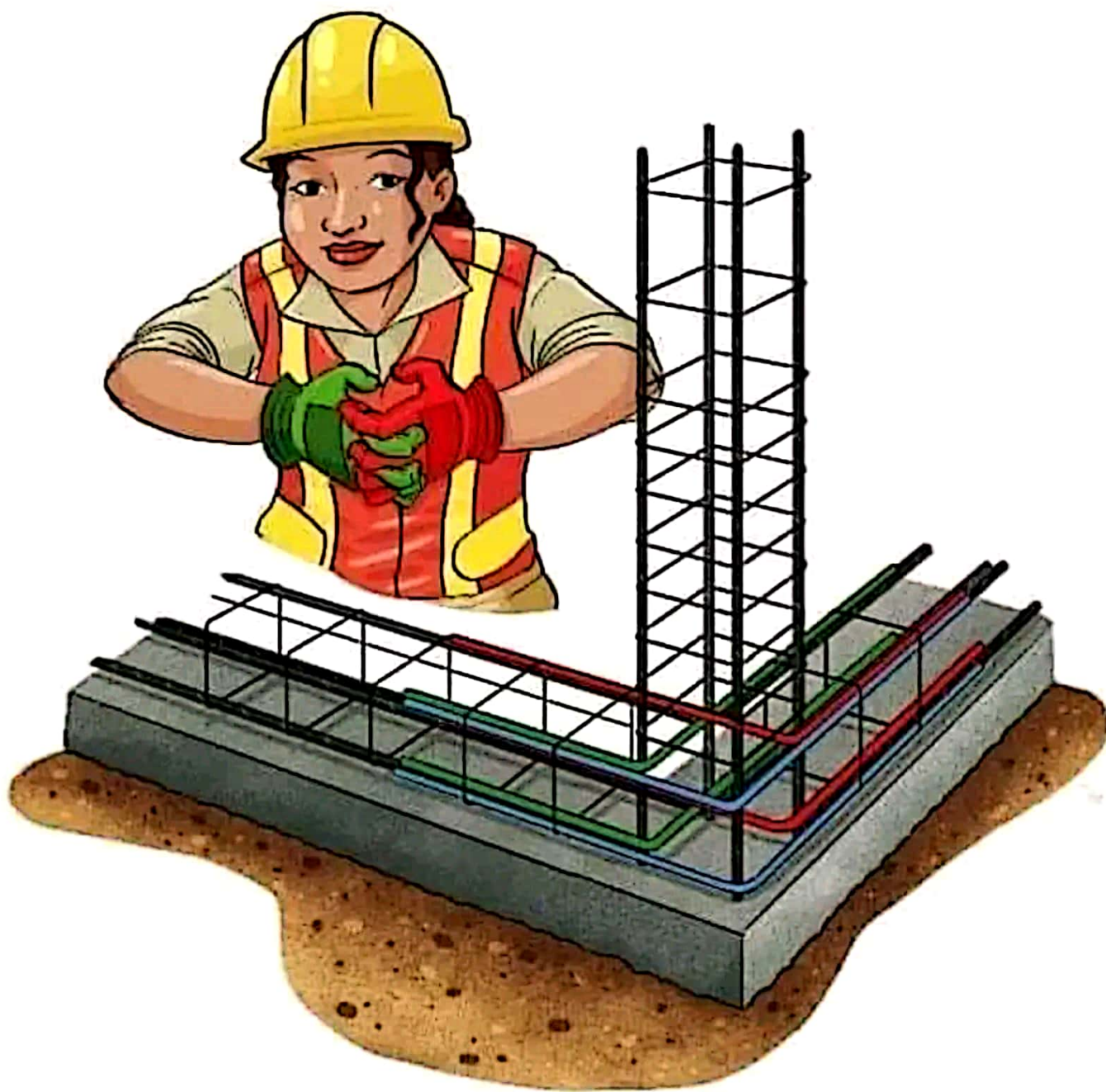
$$\begin{aligned} \text{Quantity of Paint} &= \frac{800}{200} \\ &= 4 \text{ gallon} \\ &= 4 \times 3.785 \text{ liters} \\ &= 15.14 \text{ Liters} \end{aligned}$$



US Gallon = 3.785 liters

UK Gallon = 4.540 liters

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Al cruzar las vigas de amarre, las varillas deben ir desde adentro hacia afuera, como cuando se cruzan los dedos de ambas manos.

- Calculate cement sand **agg.in** 1cubm of M25 grade concrete.

- ratio of M25 = 1: 1: 2
- Sum of ratio = 1+1+2 =4
- Wet volume = 1cubm
- Dry volume = $1 \times 1.54 = 1.54$

- Calculation =.

- ratio = C =1, S= 1, A = 2

- Cement = $\frac{1.54 \times 1 \times 1440}{4 \times 50} = 11.09$

11.09~11 bag of cement

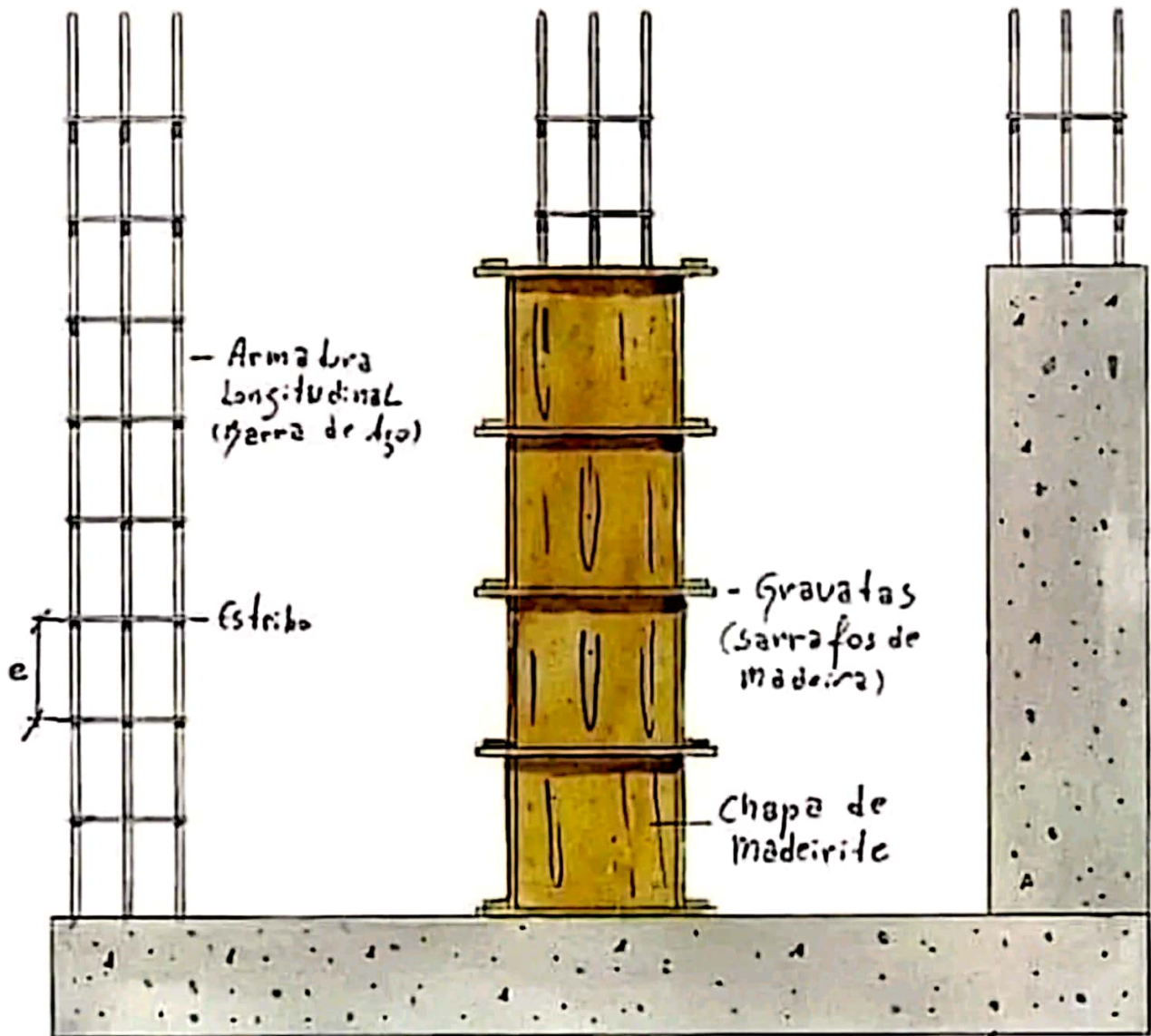
- Sand =. $\frac{1.54 \times 1}{4} = 0.385 \text{ m}^3$

- Aggregates = $\frac{1.54 \times 2}{4} = 0.77 \text{ m}^3$

1ª Armadura

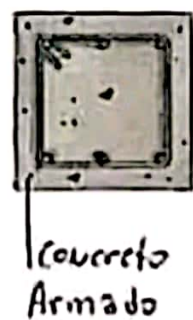
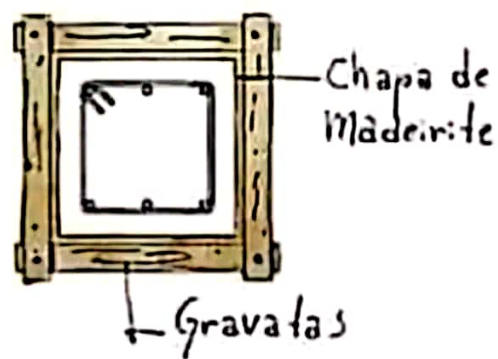
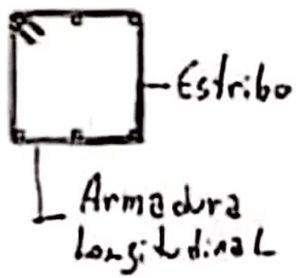
2ª Forma

3ª Concreto



@arquitetapage

17/03/2019



THUMB RULE FOR STEEL IN RCC

Type of structure	Steel kg/ft
Residential building	2.5 to 4.5
Commercial Building	4.5 to 5.5
Havy structure projects	8 to 9

The steel percentage against concrete volume will vary based on the structural element and the minimum and maximum percentage of steel utilization have listed below as per IS standard

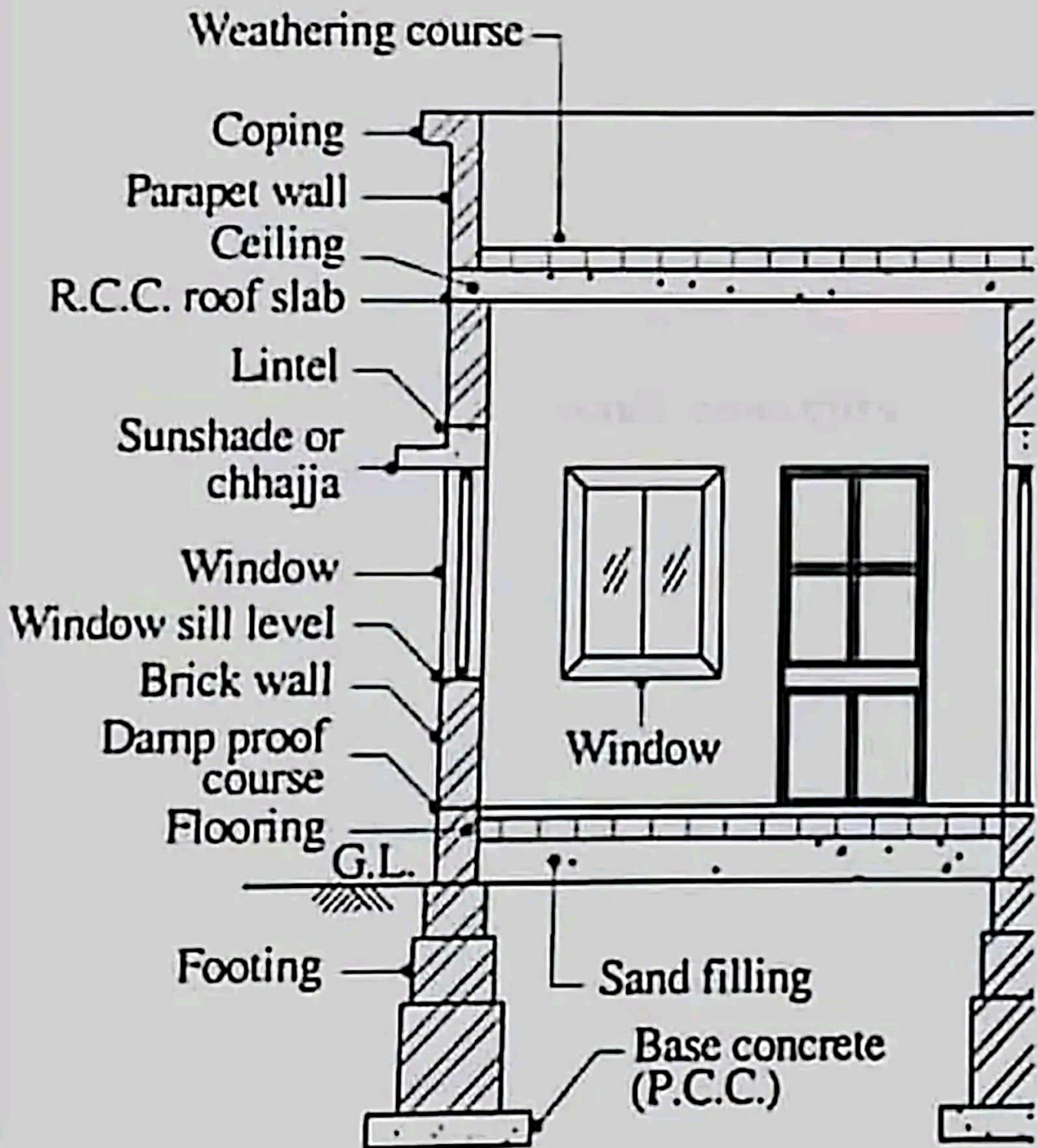
Structural element	% of steel in concrete
Slab	1%
Beam	1% to 2%
Column	2.50%
Footings	0.85%

Binding Wire

- As per IS 2502, Reinforcement are tied by binding wires, diameter not less than 0.9 mm
 - Generally 10 kg binding wire required for 1 ton reinforcement as per design.
 - For Slab: 2.7 kg for 10 sqm area.
- 18 Gauge**



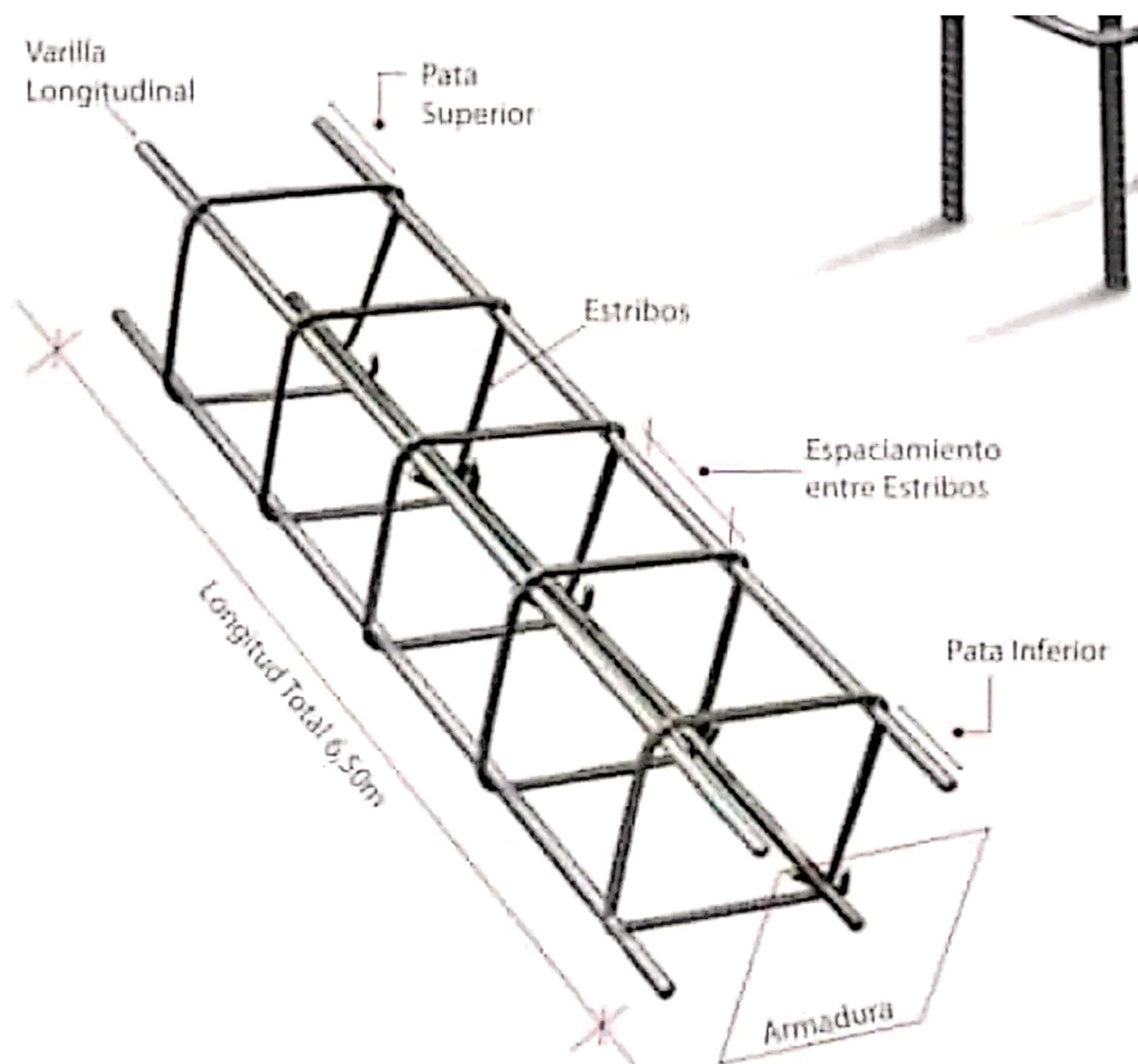
Elements of structure

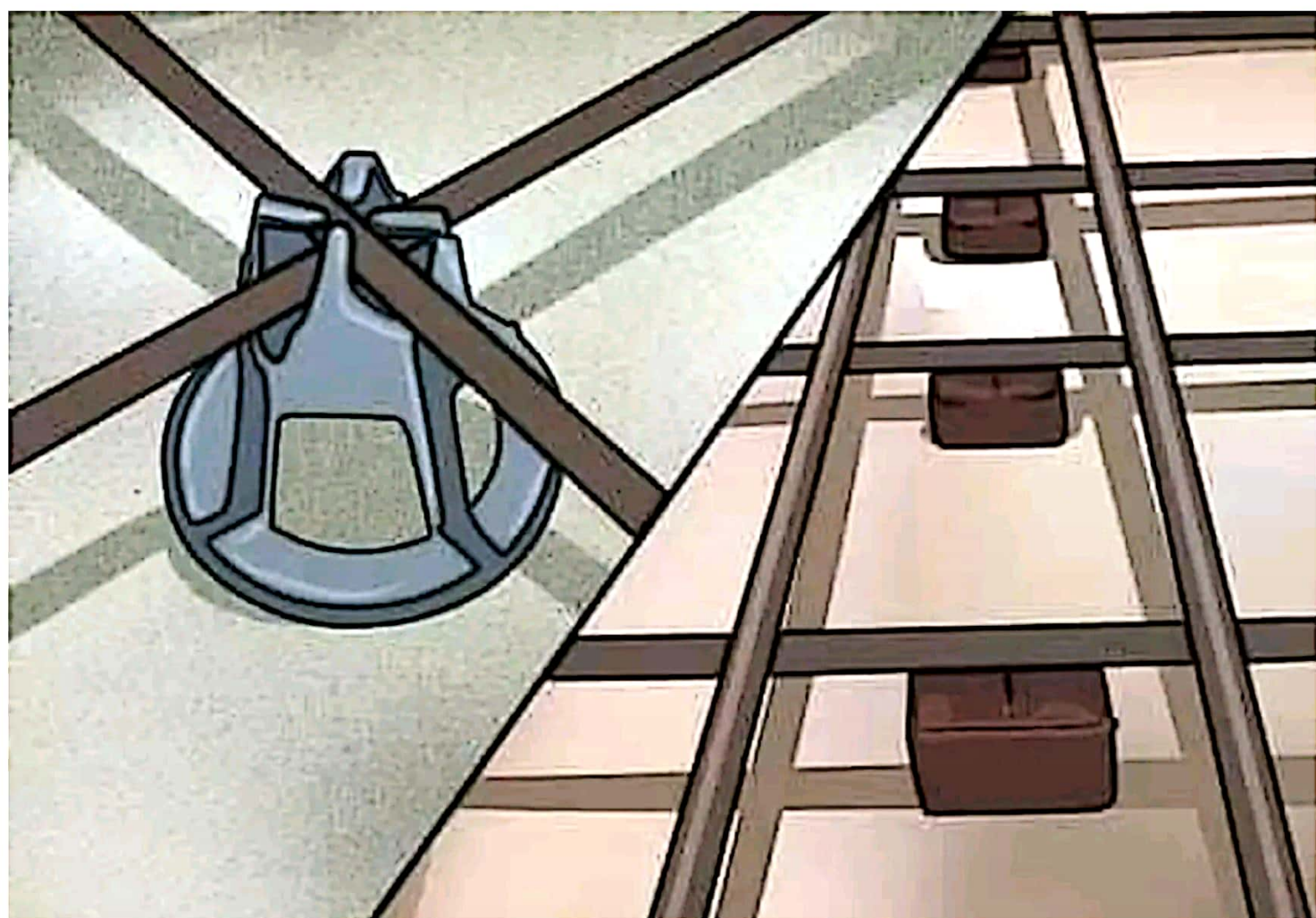


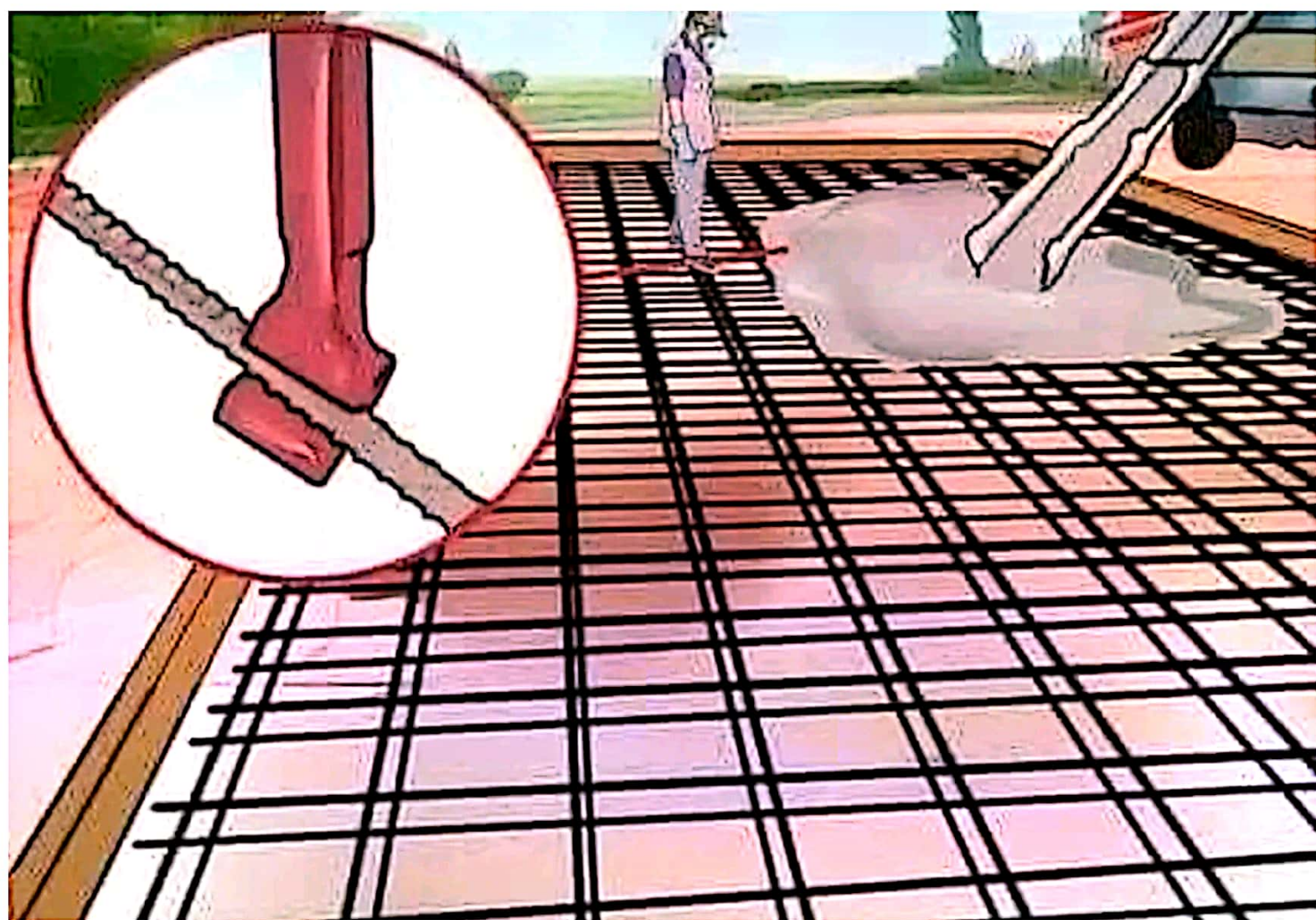
Bar Bending Schedule for Slab

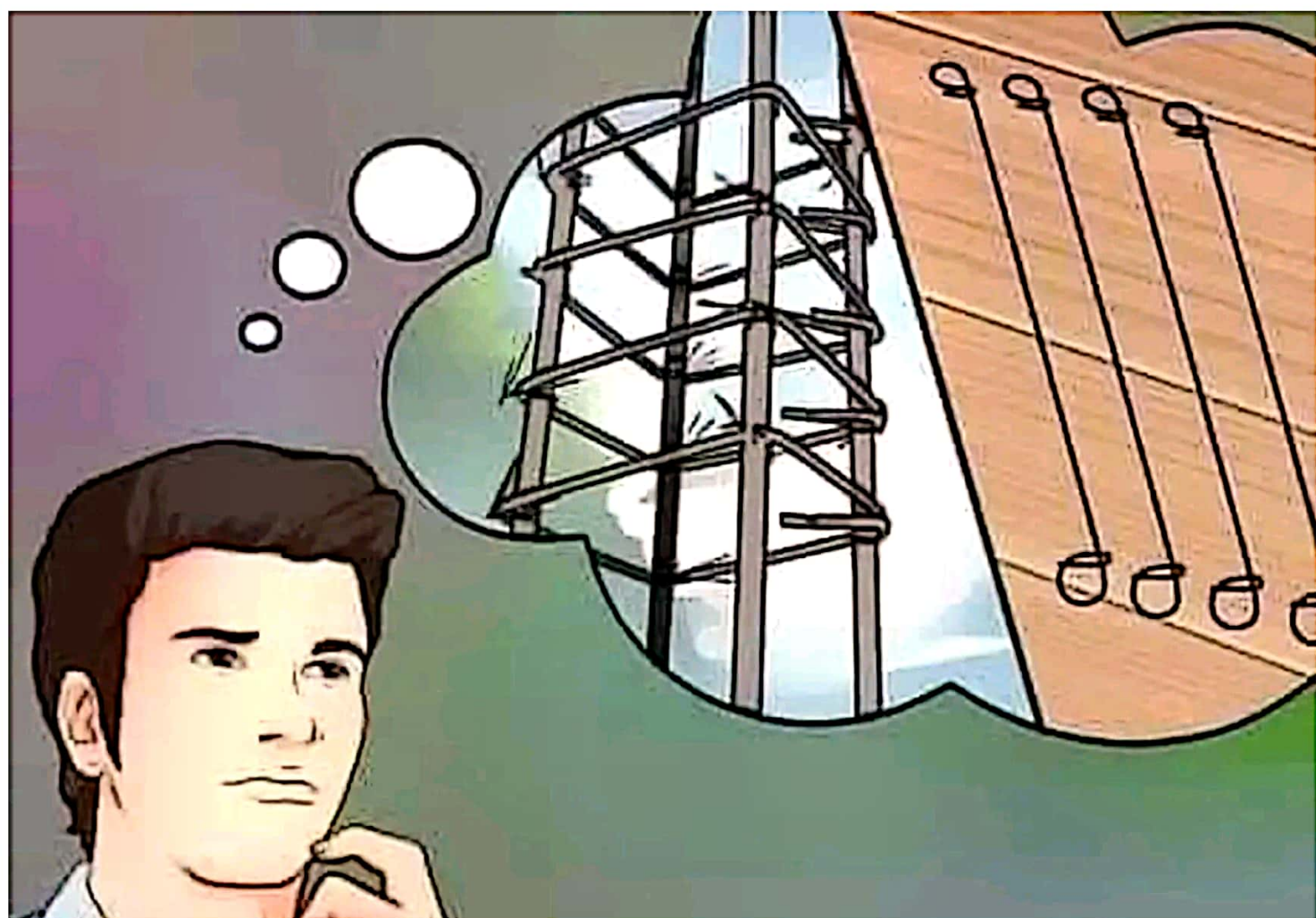
DIA OF BAR	SHAPE AND LENGTH OF BAR	LENGTH	NO	TOTAL LENGTH	UNIT WEIGH IN Kg/m	TOTAL WEIGHT
12 mm dia. Main steel		3.61	30	108.20	0.89	96.38
8 mm dia. Distribution Steel		4.51	30	135.30	0.40	54.12

What Is Bar Bending Schedule (BBS) and How to Prepare Bar Bending Schedule



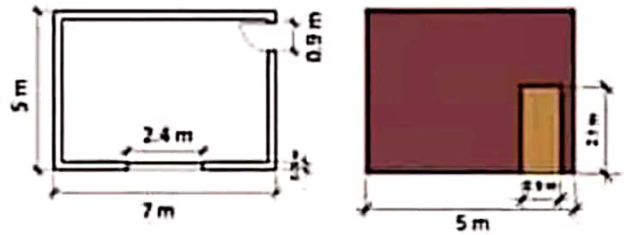
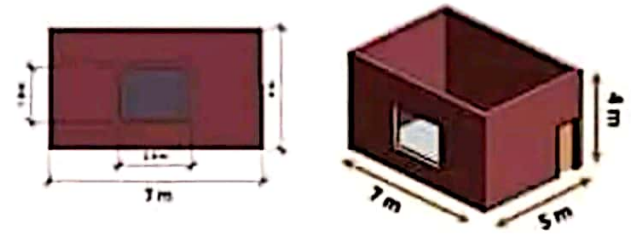






Brick Quantity: Calculate Bricks in Room

Length of Room (L) = 7 m
 Width of Room (W) = 5 m
 Height of Room (H) = 4 m
 Thickness of Wall (T) = 0.25 m
 Size of Door = 2.1×0.9
 Size of Window = 1.8×2.4
 Size of Brick = $19\text{ cm} \times 9\text{ cm} \times 9\text{ cm}$



Length of Long Wall = $7 \times 2 = 14\text{ m}$

Volume of Long Wall = $L \times W \times T$
 = $14 \times 4 \times 0.25$
 = 14 m^3

Deduction of Window = $14 - (1.8 \times 2.4 \times 0.25)$
 = 12.92 m^3

Length of Short Wall = $\{5 - (0.25 \times 2)\} \times 2 = 9\text{ m}$

Volume of Short Wall = $L \times W \times T$
 = $9 \times 4 \times 0.25$
 = 9 m^3

Deduction of Door = $9 - (2.1 \times 0.9 \times 0.25)$
 = 8.53 m^3

Total Volume = $12.92 + 8.53 = 21.45\text{ m}^3$

Mortar Thickness = $10\text{ mm} = 0.01\text{ m}$

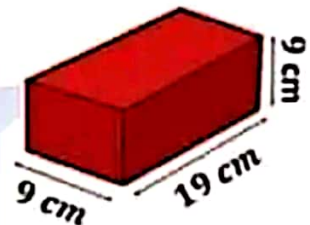
Volume of Brick = $L \times W \times T$ (With Mortar)
 = $0.20 \times 0.10 \times 0.10$
 = 0.002 m^3

Number of Bricks = $\frac{21.45}{0.002} = 10725\text{ Bricks}$

Adding the 5% wastage of Bricks = $10725 \times \frac{5}{100} = 536.25$

Hence,

Total Number of Bricks = $10725 + 536.25 = 11261.25$
 $\approx 11262\text{ Bricks}$



Calculation Quantity of Cement, Sand and Brick in One Cubic Meter

We Know

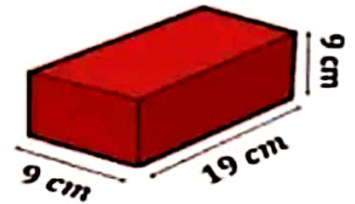
$$\begin{aligned}\text{Mortar Ratio} &= 6:1 = 7 \\ \text{Mortar Thickness} &= 10 \text{ mm} = 0.01 \text{ m} \\ \text{Density of Cement} &= 1440 \text{ kg/m}^3\end{aligned}$$

Brick for 1 m³

$$\begin{aligned}\text{Volume of Brick} &= L \times W \times T \quad (\text{Without Mortar}) \\ &= 0.19 \times 0.09 \times 0.09 \\ &= 0.001539 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Volume of Brick} &= L \times W \times T \quad (\text{With Mortar}) \\ &= 0.20 \times 0.10 \times 0.10 \\ &= 0.002 \text{ m}^3\end{aligned}$$

$$\text{Number of Bricks } 1\text{m}^3 = \frac{1}{0.002} = 500 \text{ Bricks}$$



$$\begin{aligned}\text{Volume of Mortar} &= 1 - (500 \times 0.001539) \quad (\text{WET Volume}) \\ &= 0.2305 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Dry Volume of Mortar} &= (0.2305 \times 1.33) \\ &= 0.306565 \text{ m}^3\end{aligned}$$

Cement for 1 m³

$$\begin{aligned}\text{Quantity of Cement} &= \frac{1}{7} \times 0.306565 \times 1440 \\ &= 63 \text{ kg}\end{aligned}$$

$$\text{In Bags} = \frac{63}{50} = 1.26 \approx 2 \text{ bsgd}$$



Sand for 1 m³

$$1 \text{ m}^3 = 35.3147 \text{ ft}^3$$

$$\text{Quantity of Sand} = \frac{6}{7} \times 0.306565 = 0.26277 \text{ m}^3$$

$$\begin{aligned}\text{In Cubic Feet} &= 0.26277 \times 35.3147 \\ &= 9.28 \text{ ft}^3\end{aligned}$$



For 1 m³ Volume

$$\text{Total Number of Bricks} = 500 \text{ Bricks}$$

$$\text{Quantity of Cement} = 63 \text{ kg}$$

$$\text{Quantity of Sand} = 9.28 \text{ ft}^3$$



Civil Engineering

Units

Sl No	Units	
1	Area	m^2
2	Volume	m^3
3	Stress	KN/m^2
4	Strain	No Units
5	Force	KN
6	Moment	$KNm"$
7	Deflection	mm
8	Density	KN/m^3
9	Specific gravity	No Units
10	Discharge	m^3/sec

Civil Engineering

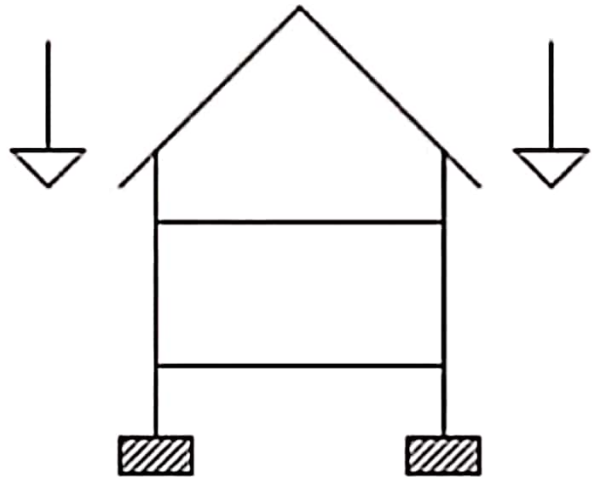
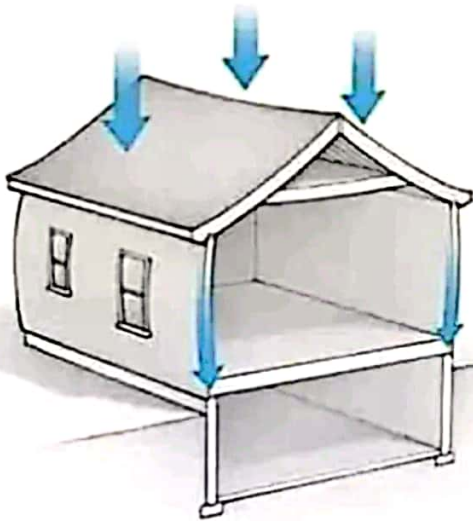
Different

Conversion & Units

Sl No	Units	Conversion
1	1m	100 cm
2	1m	1000 mm
3	1cm	10 mm
4	1m	3.28ft
5	1m	39.97 inch
6	1ft	12 inch 12"
7	1" (inch)	25.4 mm
8	1" (inch)	2.54 cm
9	1 Yard	36 inch 36"
10	1 Yard	3ft 3'
11	1m	1.0936 yard

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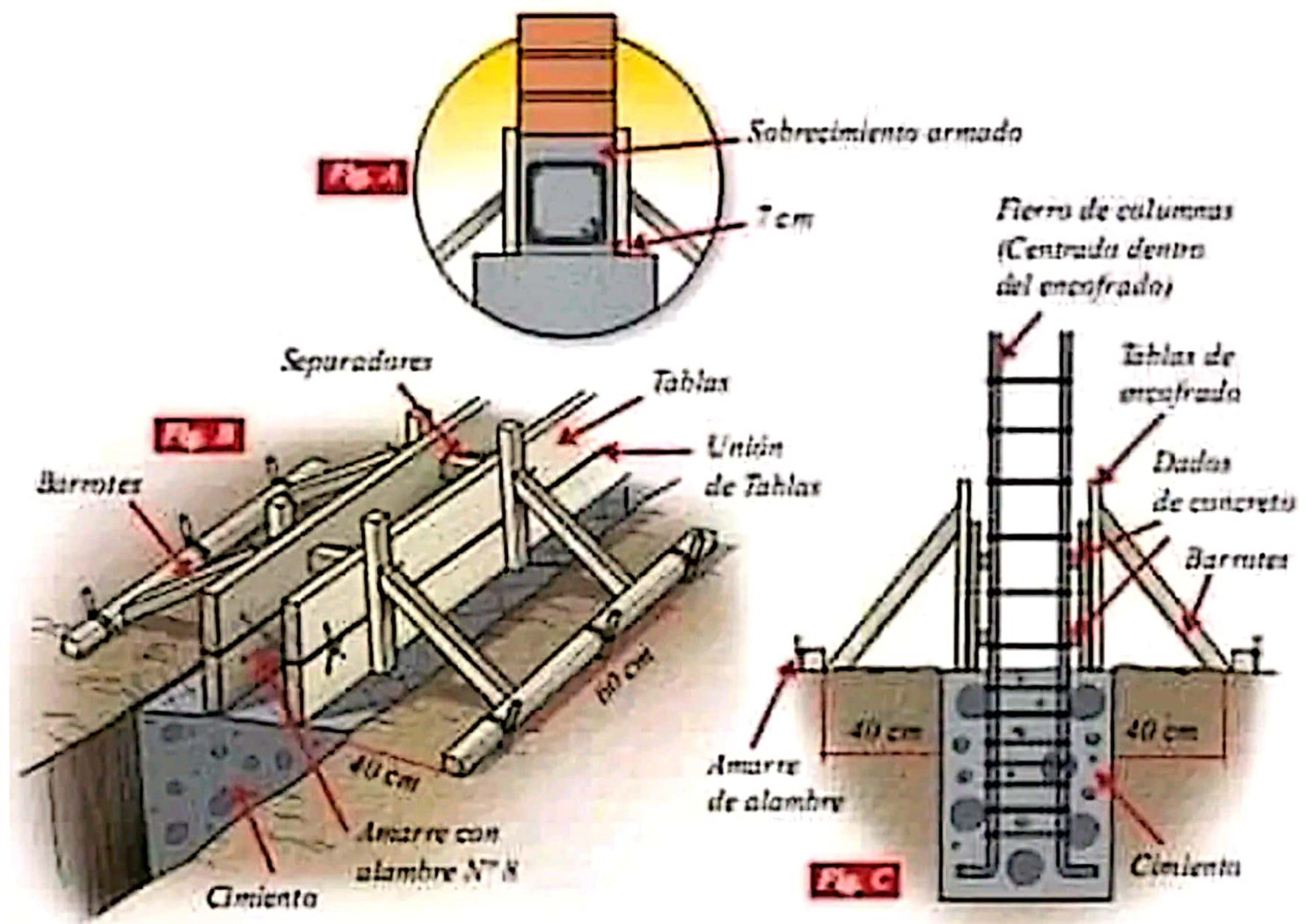
DEAD LOAD



Dead load (structure load) is a permanent/ constant load of the structure. like beam, column, slab, wall, and etc... this **static force** are called as dead load of the building.

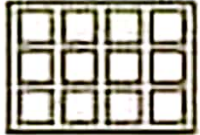
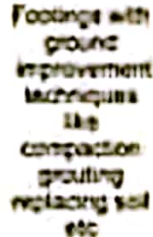
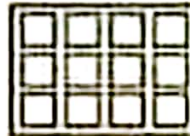
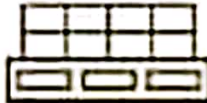
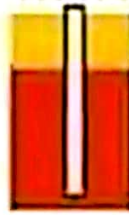
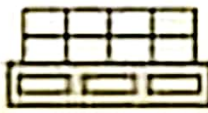
Dead load = volume of member $\times$ unit Weight of the material

Description	Percentage
Beam	2% of total volume of concrete
Column	5% of total volume of concrete
Slab	1% of total volume of concrete
Footing	0.8% of total volume of concrete



Densities of Various Construction Materials

- Steel = 7850kg/Cum
- Cement = 1440kg/cum
- Brick = 1682kg/cum or 1920kg/cum
- Sand = 1100 to 1600kg/cum
- Water = 1000kg/cum
- R.C.C = 2500kg/cum (5% STEEL)
- P.C.C = 2400kg/cum
- Wood = 1100kg/cum
- Crushed Brick = 950-1250kg/cum

Sub Soil Conditions	Foundation Possibilities	
	Light Flexible Structures	Heavy Rigid Structures
Deep compact or Stiff Soil	Footings 	Footings  Shallow Mat 
Deep compressible strata	Footings on compacted granular pad  Shallow Mat  Frictional Piles 	Deep mat with possible rigid construction in basement  Long Piles to bypass weak soils  Frictional Piles 
Soft or loose strata overlying firm strata	Bearing Piles  Footings with ground improvement techniques like compaction grouting replacing soil etc  Shallow Mat 	Bearing Piles  Deep mat with possible rigid construction in basement 
Compact or stiff layer overlying soft deposit	Footings  Shallow Mat 	Deep Mat (Floating)  Long Piles to bypass weak soils 
Alternating soft and stiff layers	Footings  Shallow Mat 	Deep Mat (Floating)  Piles  Caissons 

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Points to Remember Before Attending Interview

- Water absorption of bricks should not be more than 15 %.
- PH value of the water should not be less than 6.
- Compressive strength of Bricks is 3.5 N / mm^2 .
- In steel reinforcement binding wire required is 8 kg per MT.
- In soil filling as per IS code, 3 samples should be taken for core cutting test for every 100m^2 .

Density of Materials:

Material	Density
Bricks	1600 – 1920 kg/m^3
Concrete block	1920 kg/ m^3
Reinforced concrete	2310 – 2700 kg/ m^3

Curing time of RCC Members for different types of cement:

Super Sulphate cement: 7 days

Ordinary Portland cement OPC: 10 days

Minerals & Admixture added cement: 14 days

Abbreviations used in Civil Engineering:

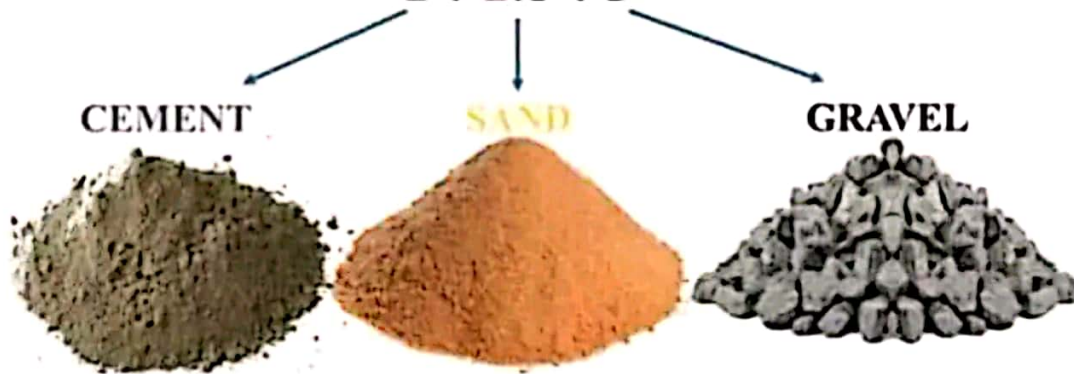
- DPC - Damp proof course.
- RCC - Reinforced cement concrete.
- RBC - Reinforced Brick concrete.
- R.B.W - Reinforced brick work.
- C.I.Sheet - Corrugated Iron sheet.
- C.I.Pipe - Cast iron pipe.
- NCF - Neat cement finishing.
- SWG - Standard wire gauge.
- MB - Measurement book.
- GP - Ground plane.
- VP - Vertical plane.
- HP - Horizontal plane.
- CP - Cement plaster.
- LC - Lime concrete.
- CC - Cement concrete.
- AC - Asbests cement.
- CS - Comparative statement.
- PERT - Programme Evaluation and Review Technique.
- CPM - Critical path method .
- USD - Ultimate strength design.
- W.S.D - Working stress design.
- PL - Plinth level.

VOLUME OF CONCRETE = 1 M³

Now let us consider M20 grade concrete

As per IS456:2000, M20 Grade concrete proportion is

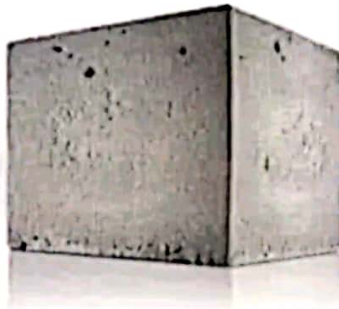
1 : 1.5 : 3



We Have To Add All The Volume To Know The **Total Volume = 1 + 1.5 + 3 = 5.5**

“As we know that during concreting when we place wet concrete, it gets harden after certain standard time. Considering the same it had be decided upon by Civil design Engineers to take a factor of safety ranging from 1.54 to 1.57 to counter that shrinkage”

DRY CONCRETE



WET CONCRETE

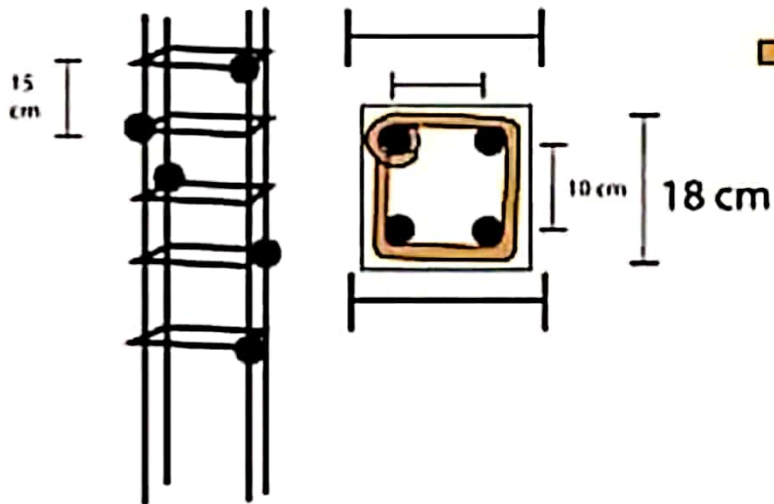


VOLUME OF DRY CONCRETE = 1.54 TO 1.57 TIMES VOLUME OF WET CONCRETE

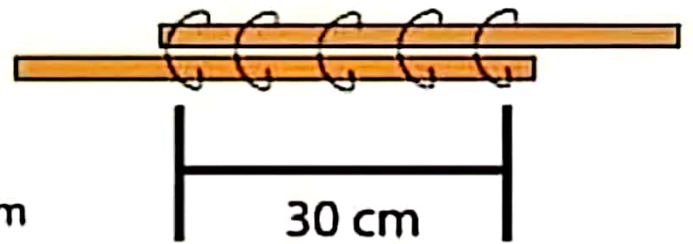
Dry Volume of Concrete = 1 x 1.54 = 1.54 m³ (For Dry Volume Multiply By 1.54)

VOLUME OF CEMENT	VOLUME OF SAND	VOLUME OF AGGREGATE
$\frac{\text{CEMENT}}{\text{CEMENT}+\text{SAND}+\text{AGGREGATE}} \times 1.57$ $\frac{1}{1+1.5+3} \times 1.57$ $= 0.28 \text{ M}^3$ $1\text{M}^3 \text{ CEMENT} = 1440\text{KGS}$ $0.28 \text{ M}^3 \text{ CEMENT} = 0.28 \times 1440$ $= 403.2 \text{ KGS}$ $\text{No. Of Cement Bags Required}$ $\text{For 1m}^3 \text{ Of Concrete}$ $= 403.2/50 = 8.06 \sim 8 \text{ Bags}$	$\frac{\text{SAND}}{\text{CEMENT}+\text{SAND}+\text{AGGREGATE}} \times 1.57$ $\frac{1.5}{1+1.5+3} \times 1.57$ $= 0.42 \text{ M}^3$ $1\text{M}^3 \text{ SAND} = 1600\text{KGS}$ $0.42 \text{ M}^3 \text{ SAND} = 0.42 \times 1600$ $= 672 \text{ KGS}$ $\text{Weight Of 1 CFT Sand} = 43.30\text{kg}$ $= 672/43.30 = 15.51 \sim 16 \text{ cft}$	$\frac{\text{AGGREGATE}}{\text{CEMENT}+\text{SAND}+\text{AGGREGATE}} \times 1.57$ $\frac{3}{1+1.5+3} \times 1.57$ $= 0.85 \text{ M}^3$ $1\text{M}^3 \text{ AGG} = 1800\text{KGS}$ $0.85 \text{ M}^3 \text{ AGG} = 0.85 \times 1800$ $= 1356 \text{ KGS}$ $\text{Weight Of 1 CFT Agg} = 68.15 \text{ kg}$ $= 1356/68.15 = 21.47 \sim 21 \text{ cft}$

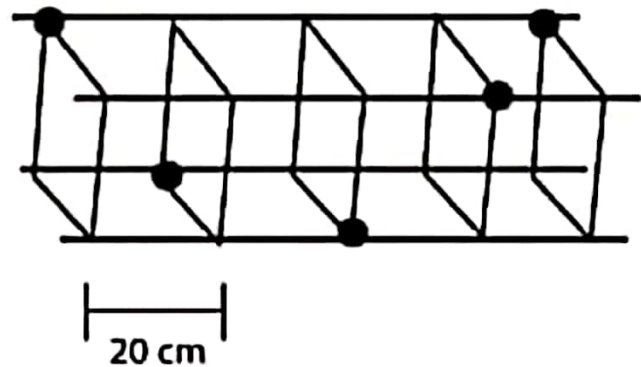
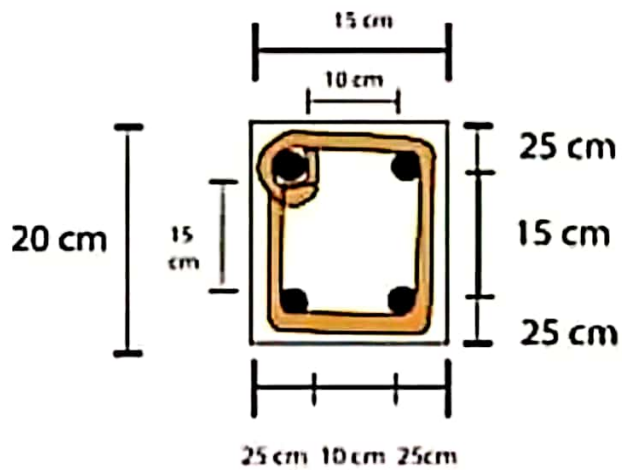
Column



Overlap



Beam



NO	TYPE OF CEMENT	IS CODE	WHERE USED
1	ORDINARY CEMENT		
	C-33 GRADE	IS:269	All general Concreting works
	C-43 GRADE	IS:8112	<u>Multistorey</u> structures. Bridges or tall structures.
	C-53 GRADE	IS:12269	<u>Prestressed</u> concrete work
2	Rapid Hardening Portland Cement	IS: 8041	Road works and Repairs.
3	Low Heat Portland Cement	IS: 12600	Mass concrete Dams
4	Portland slag cement	IS:455	Marine Structure
5	Portland <u>Pozzolana</u> Cement	IS:1489	Mass Concrete-Marine Structure and general building works
6	<u>Sulphate</u> Resisting Portland Cement	IS:12330	Marine Structures foundation in <u>Sulphate</u> bearing soils
7	Hydrophobic Cement	IS:8043	Swimming pools floor of food processing plants
8	High Alumina Cement	IS :6452	Marine Structures
9	<u>Supersulphate</u> Cement	IS:6909	Marine Structures construction of sewers

DIFFERENT TYPES OF CONCRETE GRADE

Concrete Grade	Mix Ratio (cement : sand : aggregates)
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➤ M5	- 1:5:10
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➤ M7.5	- 1:4:8
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➤ M10	- 1:3:6
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➤ M15	- 1:2:4
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➤ M20	- 1:1.5:3
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➤ M25	- 1:1:2
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After M-25 we refer IS 10262

DESIGN MIX : M15

- M15 (1 : 2 :4)
- Cement : 316 Kg/ M3
- 20 mm Aggregate : 1320 Kg/ M3
- River sand : 638 Kg/ M3
- Total water : 140 Kg/ M3
- No. of bags = 7 bags

➤ Civil Guruji



<https://www.civilguruji.com/>

DESIGN MIX : M 20

- M20 (1:1.5: 3)
- Cement : 403.2 Kg/ M3
- 20 mm Aggregate : 1260 Kg/ M3
- River sand : 609 Kg/ M3
- Total water : 180 Kg/ M3
- No. of bags = 9 bags

DESIGN MIX : M 25

- M25 (1 : 1 : 2)
- Cement : 554.4 Kg/ M3
- 20 mm Aggregate : 1155 Kg/ M3
- River sand : 558.25 Kg/ M3
- Total water : 250 Kg/ M3
- No. of bags = 9 bags



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CLEAR COVER TO MAIN REINFORCEMENT :

- FOOTINGS : 50 mm
- RAFT FOUNDATION.TOP : 50 mm
- RAFT FOUNDATION. BOTTOM /SIDES : 75 mm
- STRAP BEAM : 50 mm
- GRADE SLAB : 20 mm
- COLUMN : 40 mm
- SHEAR WALL : 25 mm
- BEAMS : 25 mm
- SLABS : 15 mm
- FLAT SLAB : 20 mm
- STAIRCASE : 15 mm
- RET. WALL : 20/ 25 mm on earth
- RETAINING STRUCTURES : 20/30mm

REINFORCEMENT DETAILS

- FE-250.



- Where FE stands for iron and the numeric value represents the yield strength of the steel.
- Where now a days TMT are more used in construction which stands for Thermo Mechanically Treated bars.

REINFORCEMENT DETAILS

- FE-415



- Where FE stands for iron and the numeric value represents the yield strength of the steel.
- Where now a days TMT are more used in construction which stands for Thermo Mechanically Treated bars.

REINFORCEMENT DETAILS

- FE-500



- Where FE stands for iron and the numeric value represents the yield strength of the steel.
- Where now a days TMT are more used in construction which stands for Thermo Mechanically Treated bars.

1 M LENGTH STEEL ROD & ITS VOLUME

$$\begin{aligned} \blacktriangleright \quad V &= (\text{Pi}/4) * \text{Dia} \times \text{Dia} * L \\ &= (3.14/4) \times D \times D \times 1 \text{ (for 1 m length)} \end{aligned}$$

Density of Steel = 7850 kg / cub meter

$$\blacktriangleright \quad \text{Weight} = \text{Volume} \times \text{Density}$$

$(3.14/4) \times D \times D \times 1 \times 7850$ (if D is in mm), So

$$(3.14/4) \times D \times D \times 1 \times 7850) / (1000 \times 1000)$$

$$= D * D / 162.27$$

FORMAT FOR ESTIMATION SHEET

[illegible]

FORMAT FOR Bill Of Quantity

[illegible]